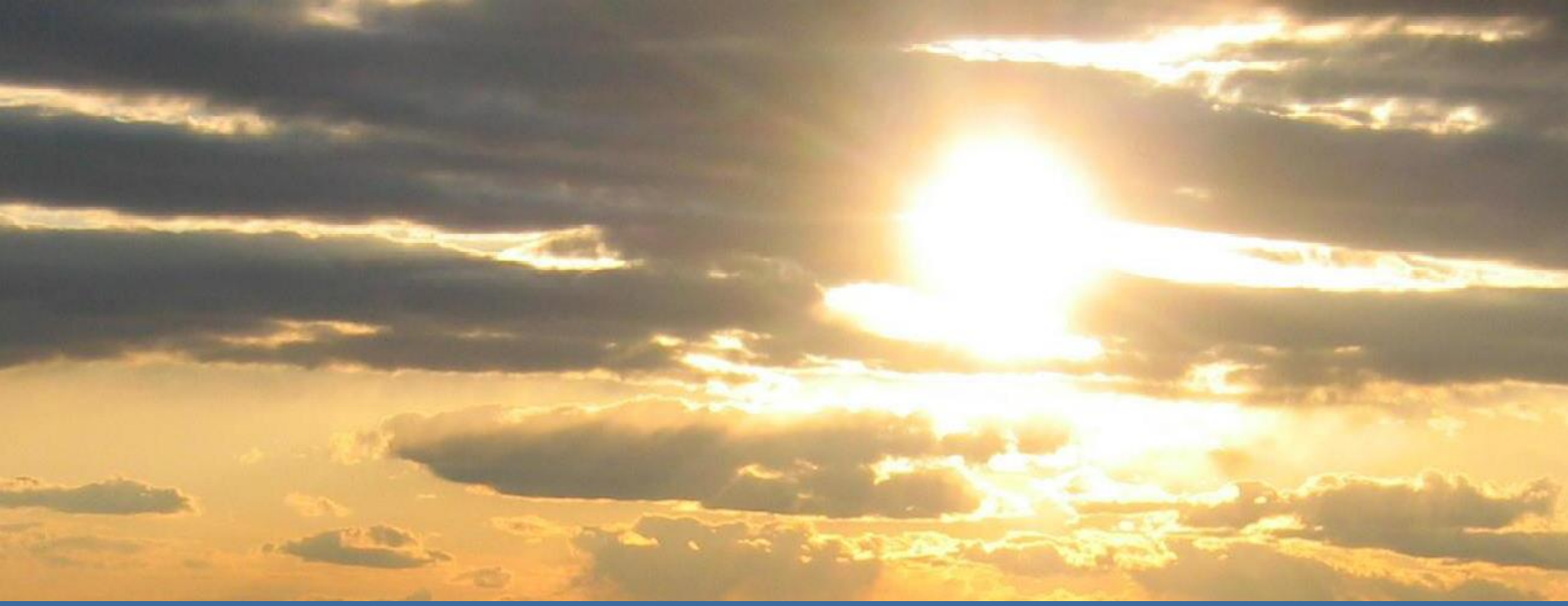


Connecticut Department of Energy and Environmental Protection

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

Exceptional Event Analysis Update Connecticut May 2016

Michael Geigert
December 21, 2016

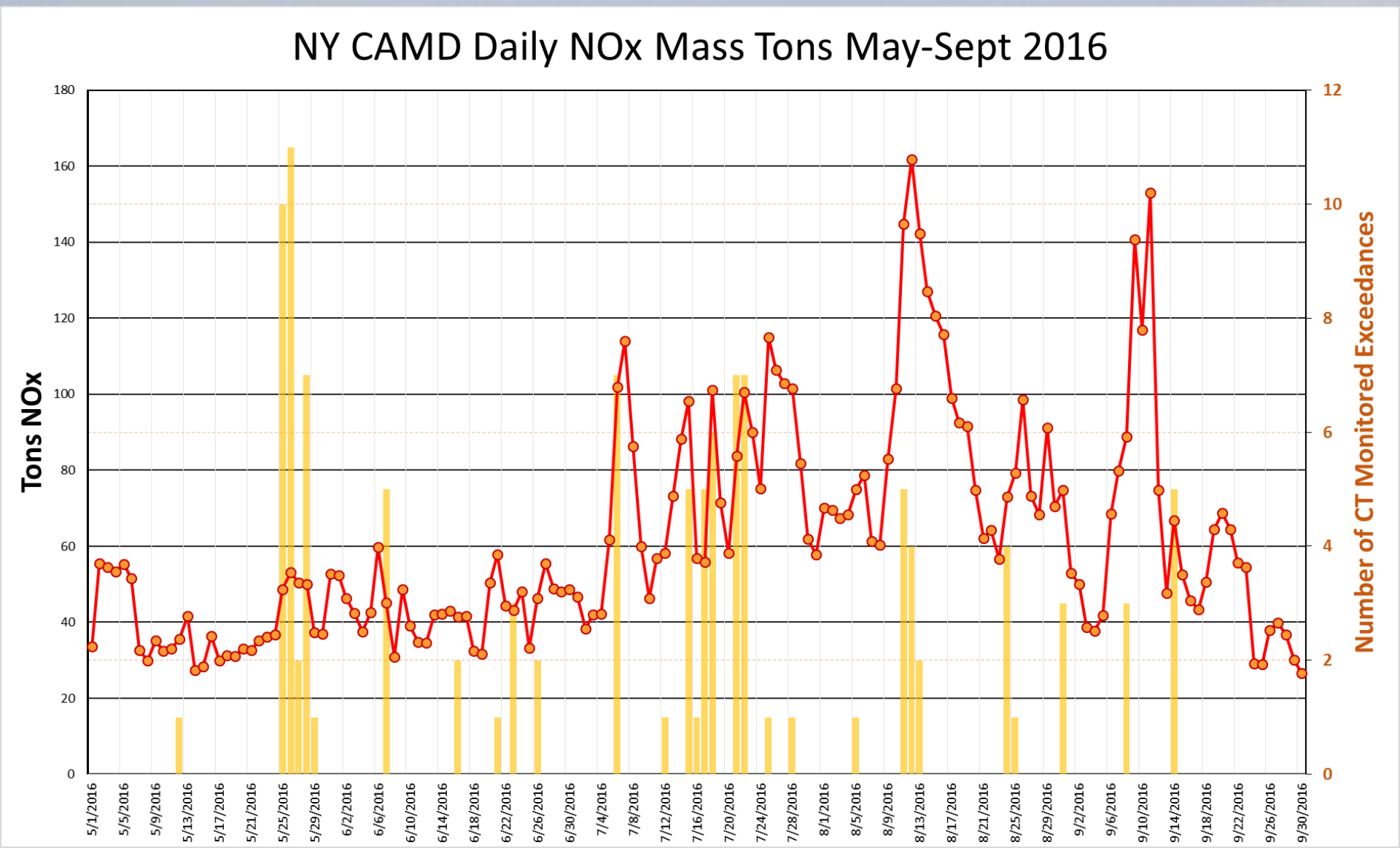
Connecticut Department of Energy and Environmental Protection

Initial Guidance from EPA Region 1

- ***"…advanced analyses will be necessary to demonstrate that the Fort McMurray is the primary reason for the high ozone concentrations recorded in Connecticut during the episode and that normal precursor emissions from the Northeast urban corridor was likely not the cause."***
- ***"…providing examples of elevated ozone concentrations in the Midwest, Canada and Upstate New York prior to the arrival of the smoke/ozone event in Connecticut."***
- ***"… meeting these criteria [99th percentile] may be difficult for all of the ozone monitors in Connecticut, you may be able to show that the high ozone concentrations measured directly upwind during episode in western Massachusetts, southern Vermont and upstate New York were truly unique over the last 5-8 years."***
- ***"…CT DEEP could look for warm summer days in the past with similar 24-hour back trajectories from southwestern Connecticut originating in western New York, and analyze the ozone concentrations on those days. In addition, CT DEEP could do an ensemble of back trajectories for all days during a given time period (e.g., 3-5 year period) when high ozone was measured in CT."***
- **"…CT DEEP could look at the NOx sources covered by the Cross State Air Pollution Rule (CSAPR) in the immediate upwind areas on these days compared to what typically happens during a severe ozone event in July or August."**

Daily NY CAMD NOx Tons 2016

- When plotted against CT monitored 2016 exceedances, May 25-26, 2016 is an outlier event compared to ozone events during the remaining ozone season.



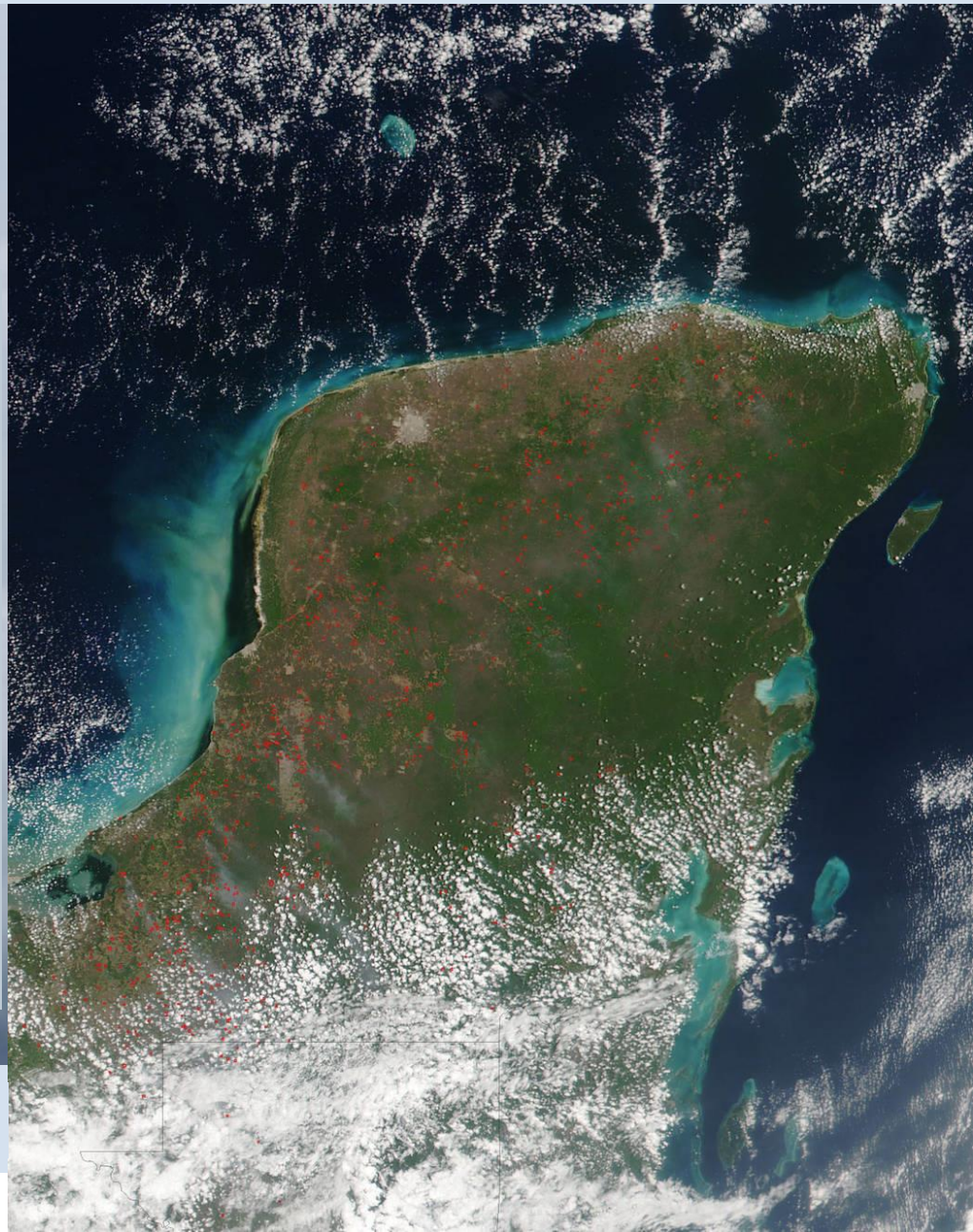
Satellite CO and BC from Wildfires

- Daily column carbon monoxide (CO) for May 2016 from OMI showed the influence of both the Canadian and the **Mexican Wildfires.**
- Black Carbon (BC) May 15-May 26 shows fresh smoke from wildfires, but does not trace the entire plume as well as from the CO images.
- After May 21st, 850 mb wind patterns allowed the plume from the Mexican fires to merge with that from the Fort McMurray fires over the upper Midwest States, which enhanced ozone production there.

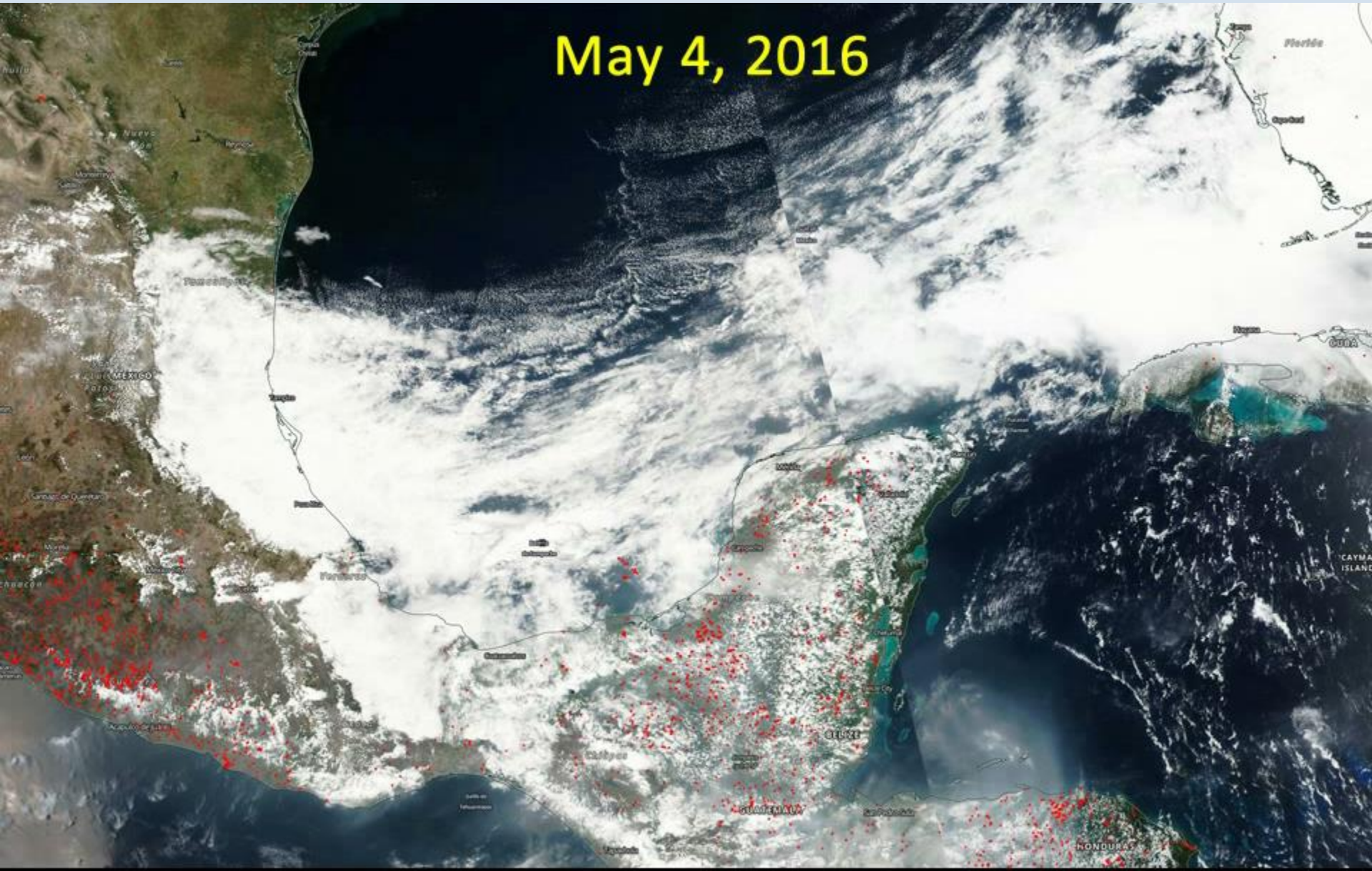
Mexico’s Yucatan Peninsula May 6, 2016

NASA report on the Yucatan fires:

May 6, 2016:
Suomi NPP's Visible Infrared Imaging Radiometer Suite (VIIRS) instrument captured a look at the fire and the smoke generated by numerous fires burning over Mexico’s Yucatan Peninsula. Actively burning areas detected by VIIRS are outlined in red. February to May is the dry season in this part of the world, and these fires may be intentional agricultural fires set by people to prepare for the upcoming growing season, or they may be accidental forest fires.

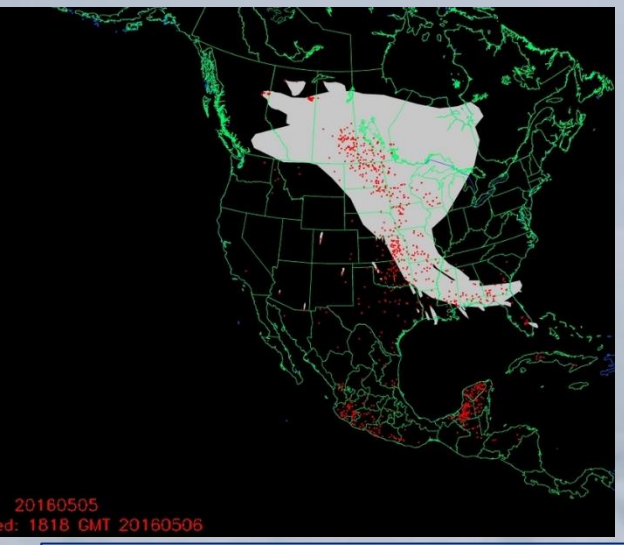


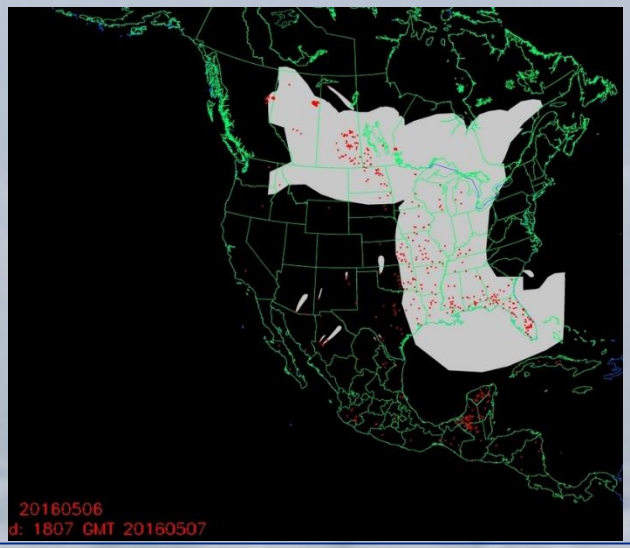
Yucatan Fires Animation

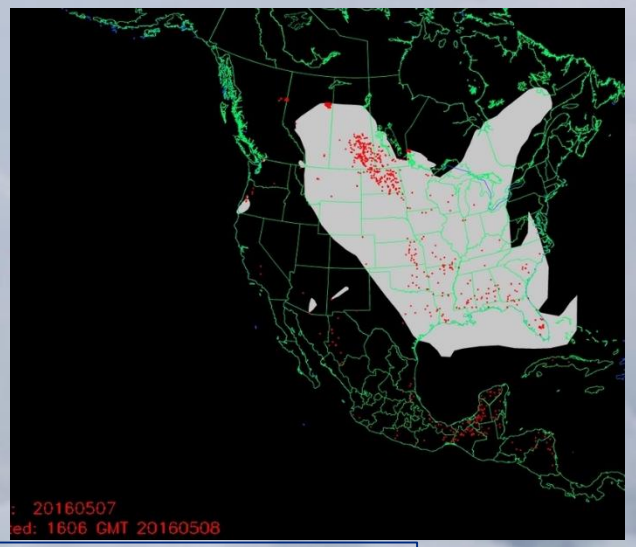


The Conceptual Model with Wildfires

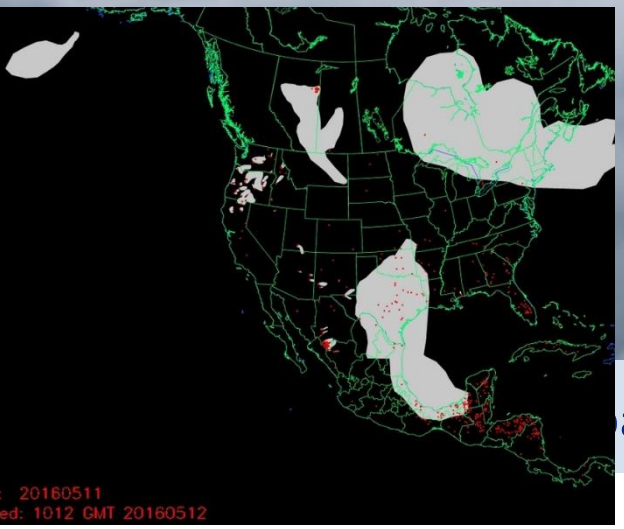
May 5-7, 2016: Southeastern US wildfires interacting with Fort McMurray plume

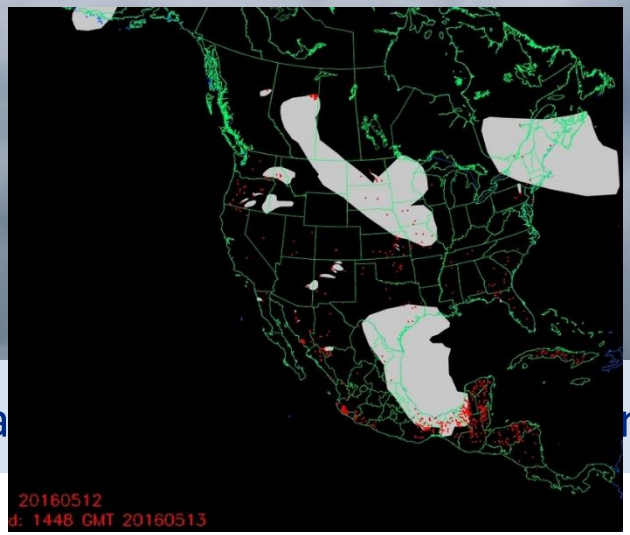


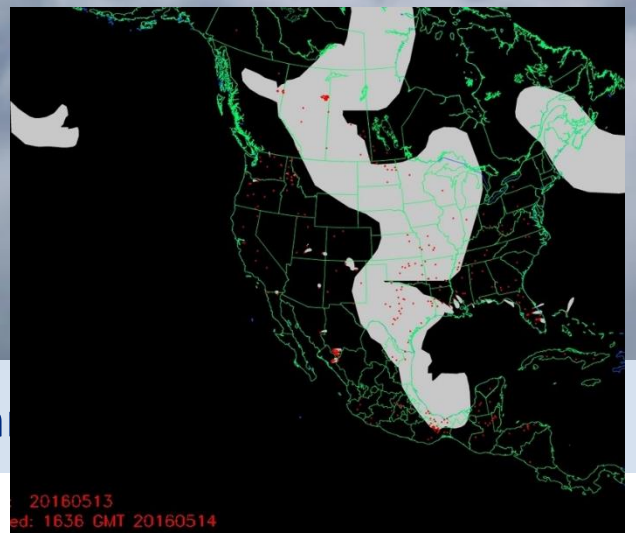




May 11-13, 2016: Mexican wildfires interacting with Fort McMurray plume







VIIRS Trajectories Documentation

48 hour Trajectory Forecast for high VIIRS AOT

The trajectory forecast animation plots latest available daily VIIRS aerosol optical thickness AOT (in blue-red rainbow color), an animated ~48 hour air parcel trajectory forecast (in magenta-white colors), and the 3hr accumulated precipitation (in yellow).

VIIRS derived aerosol optical thickness (AOT)

VIIRS AOT used for these plot is based on the VIIRS aerosol product and is from the VIIRS sensors aboard the Suomi-NPP (S-NPP) satellite. S-NPP has an ascending orbit and a 1:30pm equatorial overpass time.

Forward air parcel trajectory forecast

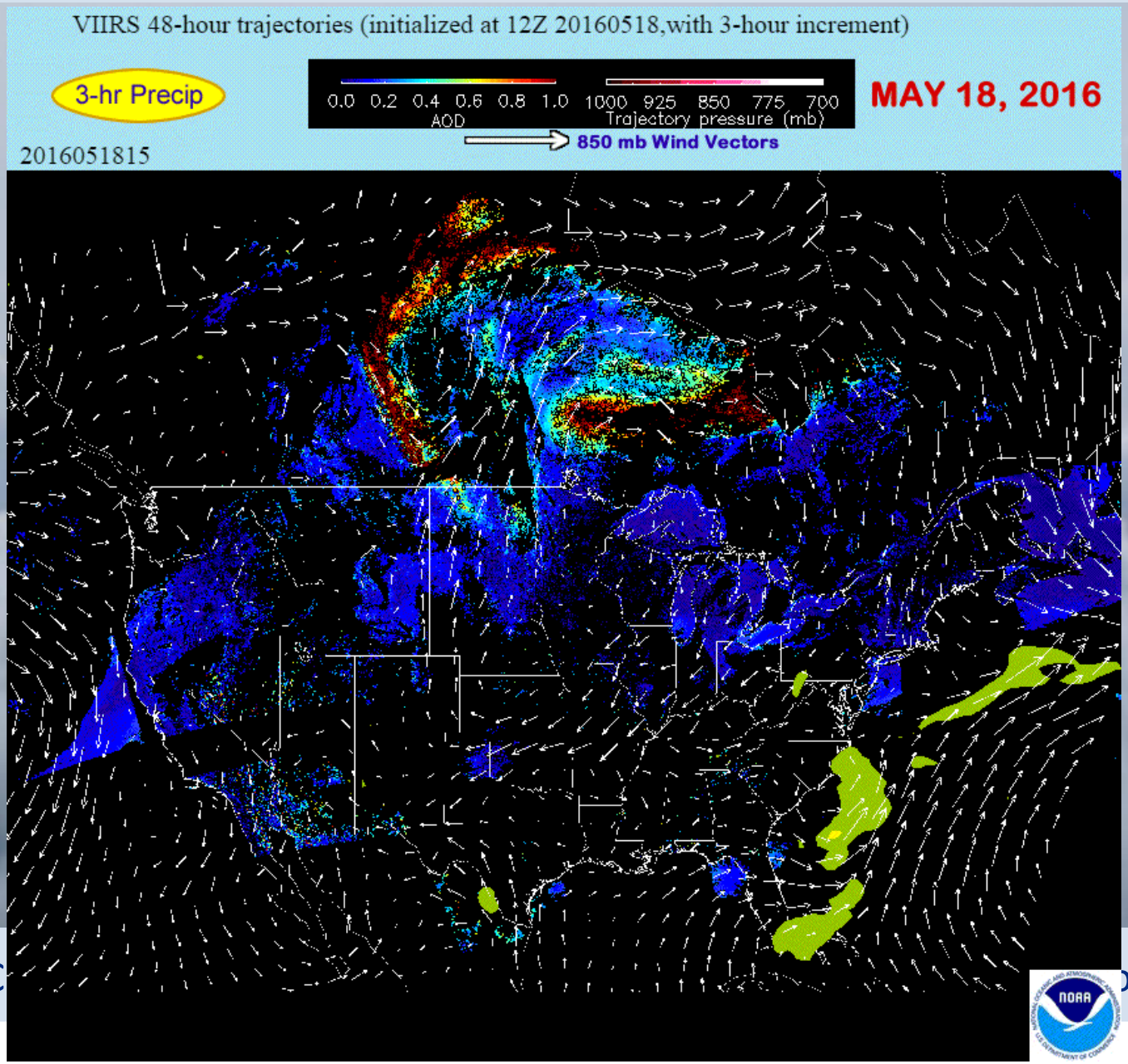
The trajectories are initialized at the high AOT value locations at 50mb, 100mb, 150mb, and 200 mb above the surface level. The initialization points for the trajectories are colored to the AOT scale and the most recent day of VIIRS data remains on the plot.

The air parcel trajectories model is run using the 12Z NOAA NAM (North American Mesoscale Model) forecast data providing a ~48hr forecast via trajectories. The pressure levels of the trajectories are plotted in mb and colored to a magenta-white scale. The forecast trajectory animation details the potential vertical movement of high aerosol loads in the troposphere. As the forecast trajectories progress in time, darker color trajectories indicate a flow of air towards the surface, and a potential similar movement of the aerosols, captured by the high AOT. White color trajectories indicate a upward movement in the air flow.

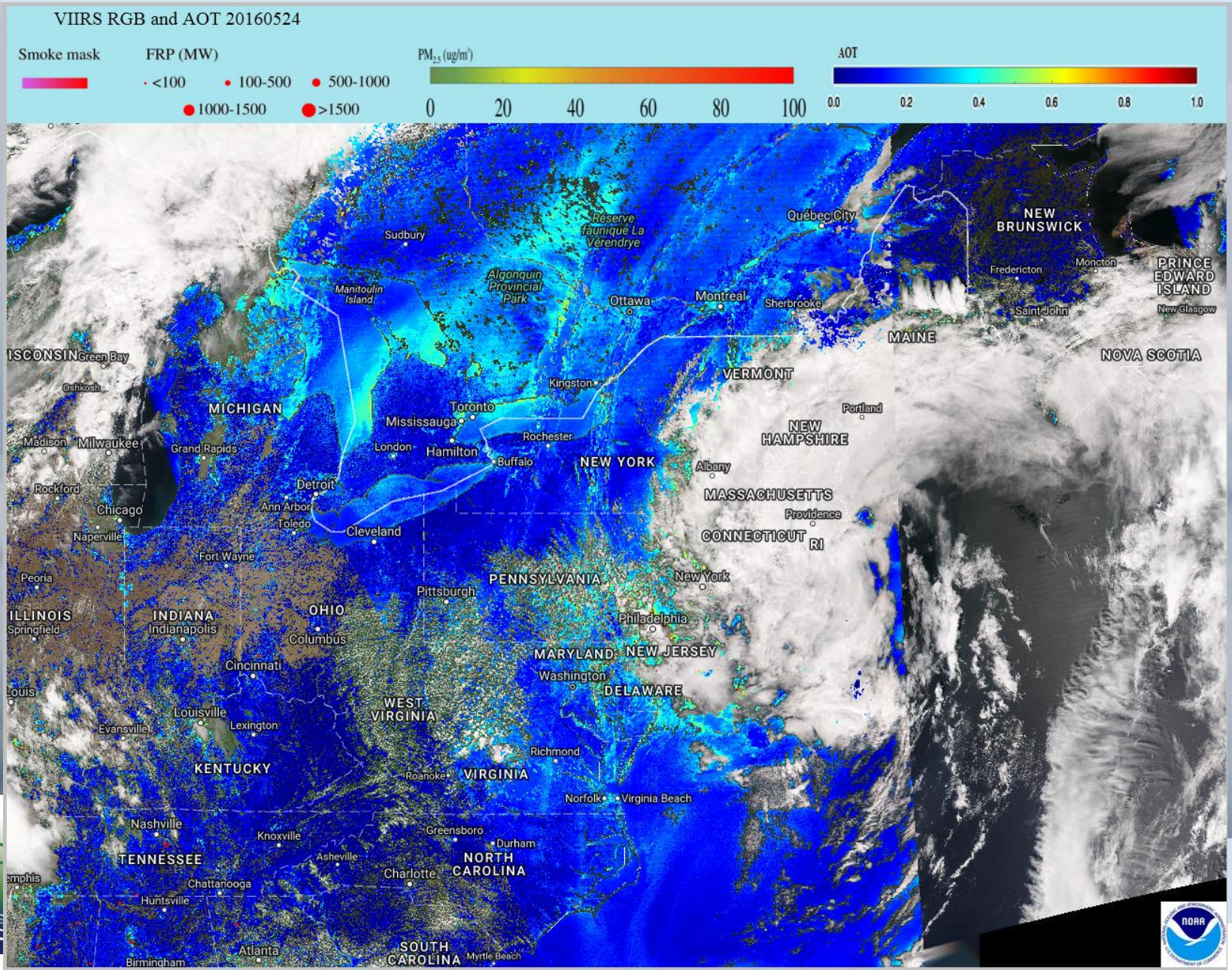
3-hour accumulated precipitation

Areas where 3 hour accumulated precipitation (NAM) is greater than 2 kg/m^2 are shaded yellow and can be used to determine rain out or potential for wet deposition in areas of high aerosol loading.

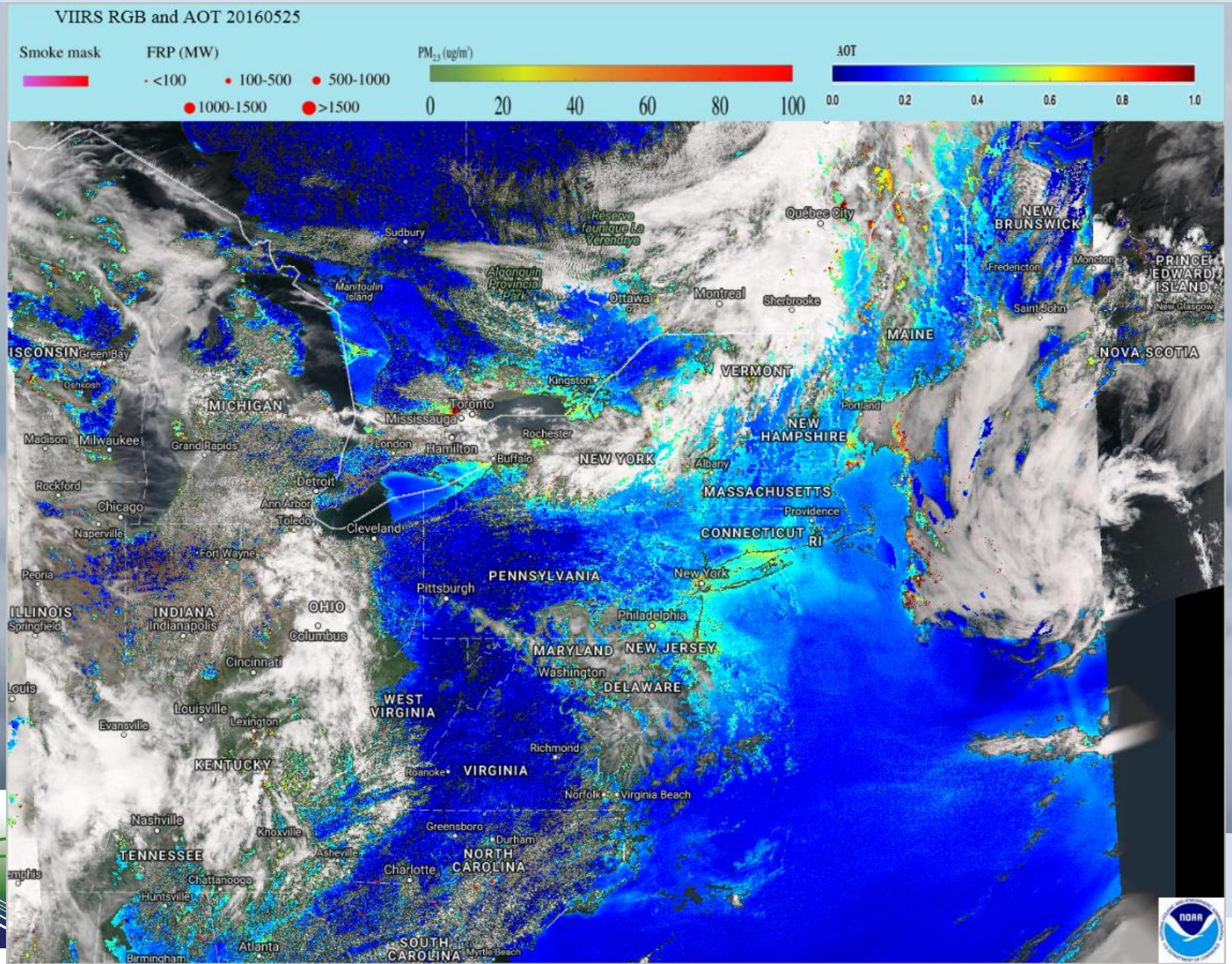
VIIRS AOT Trajectory Animation



VIIRS AOT May 24, 2016

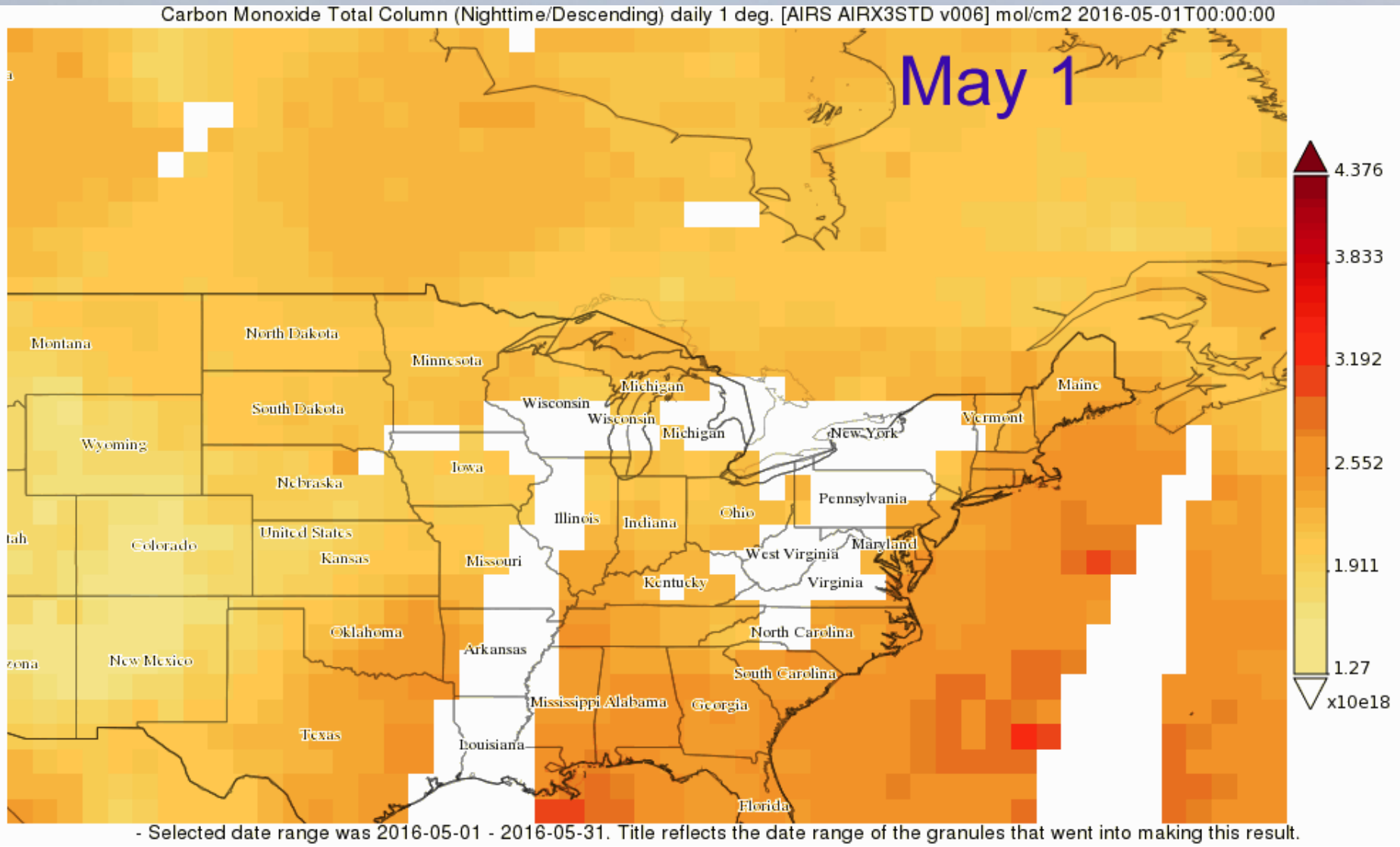


VIIRS AOT May 25, 2016



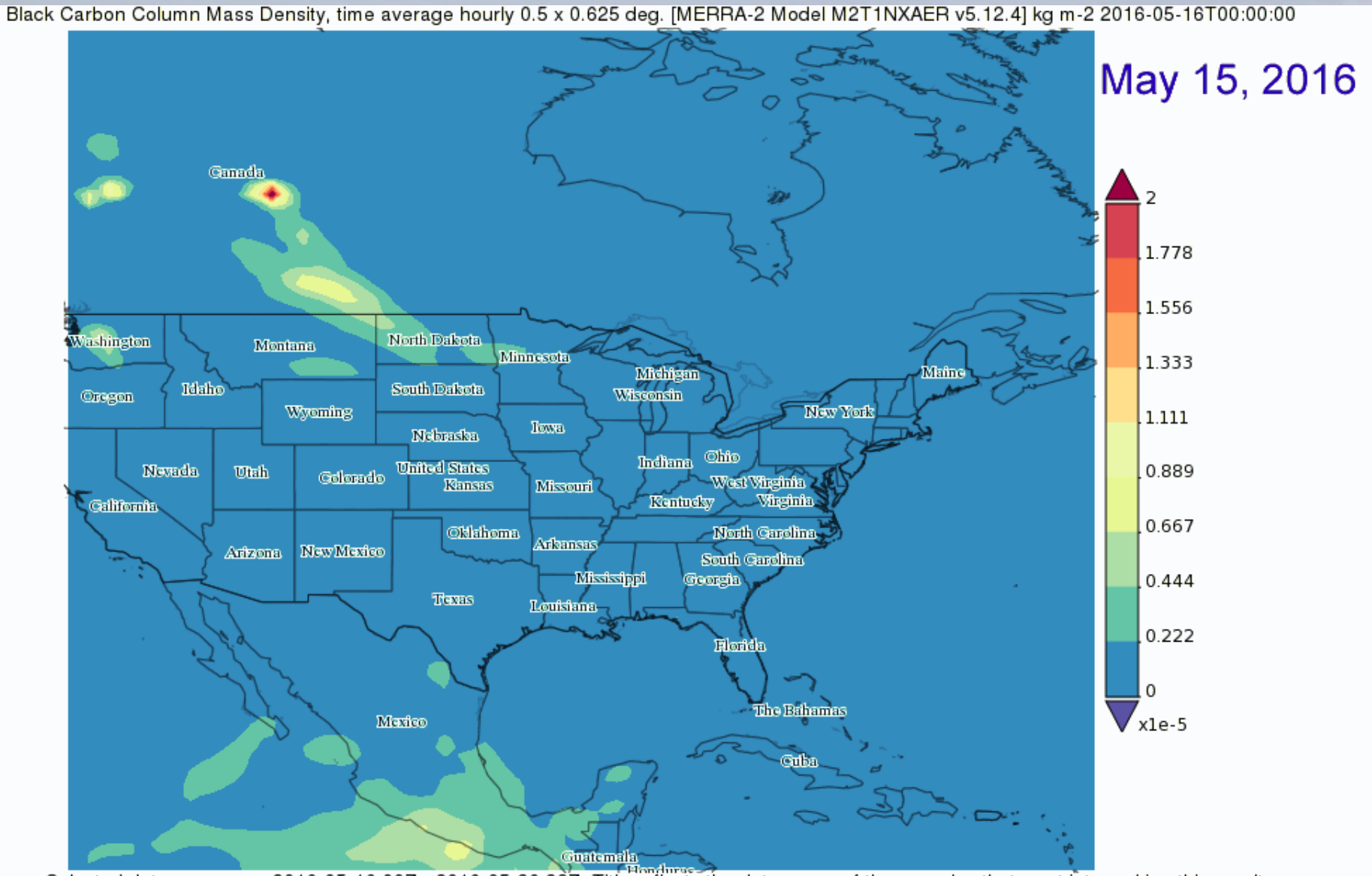
OMI CO Animation May 1- 31, 2016

- Plumes of interest are circled in red;
- CO plumes are evident over SE States due to agricultural fires, especially from Mexico



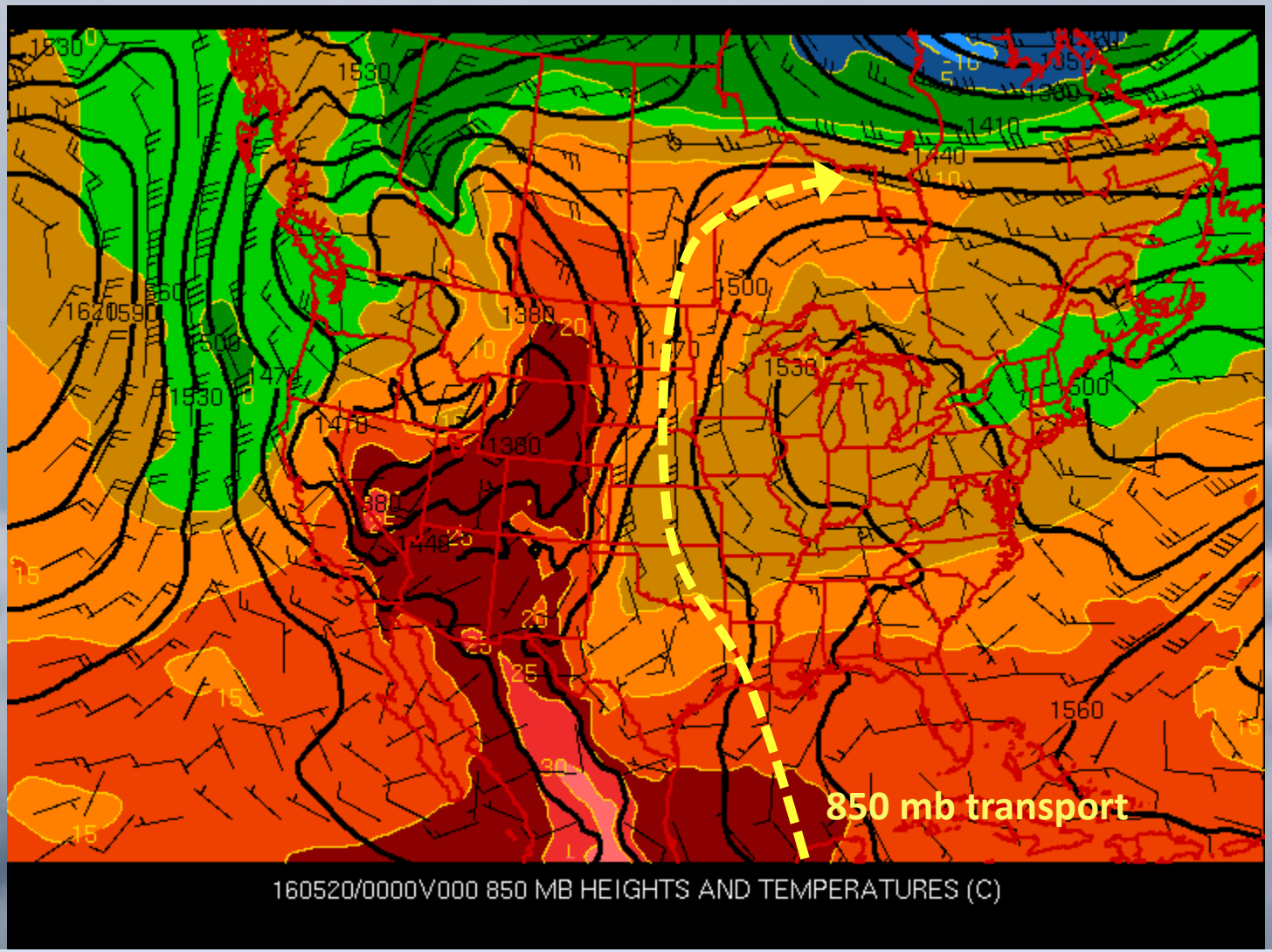
- Selected date range was 2016-05-01 - 2016-05-31. Title reflects the date range of the granules that went into making this result.

OMI BC Animation May 15-26, 2016

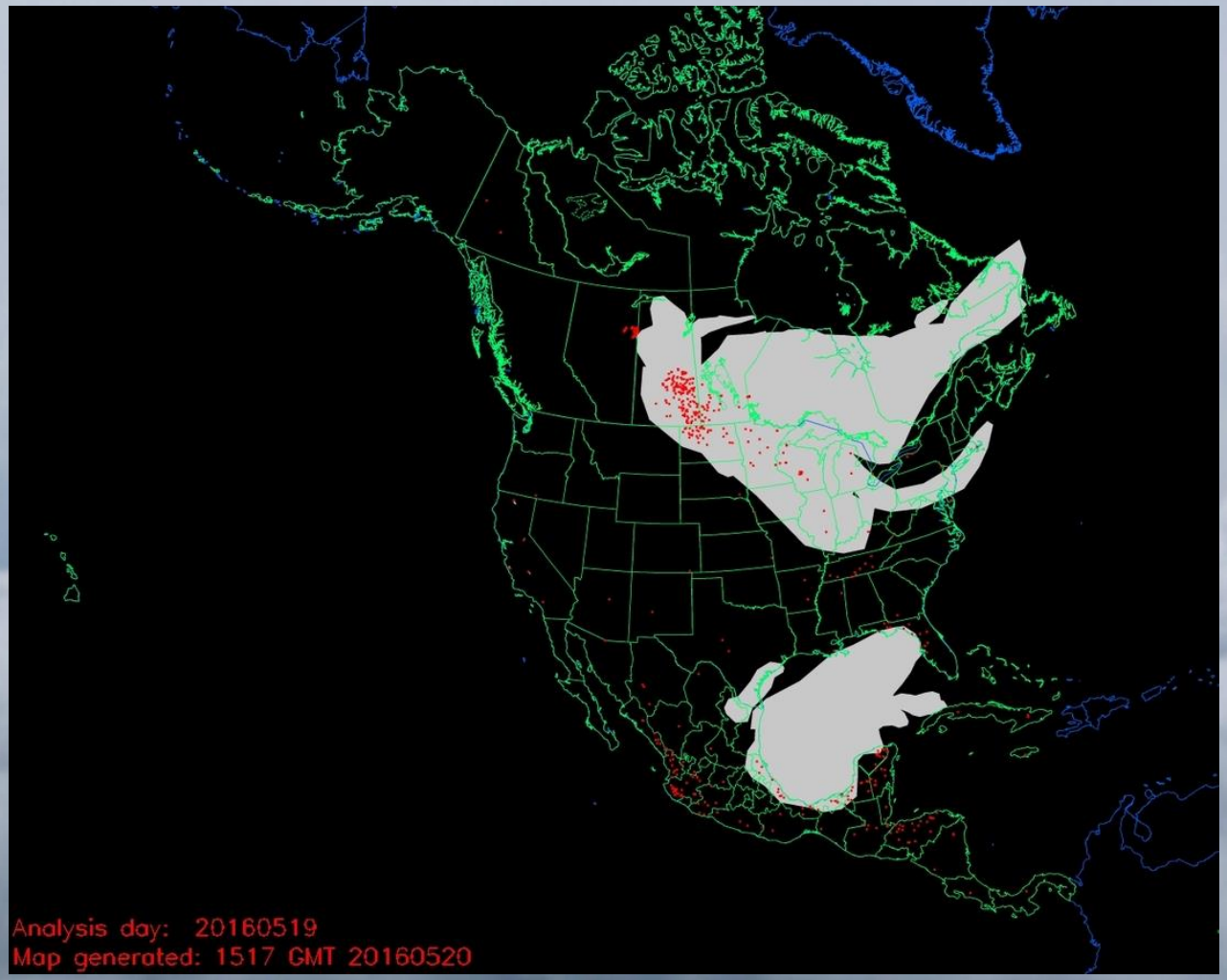


- Selected date range was 2016-05-16 00Z - 2016-05-26 23Z. Title reflects the date range of the granules that went into making this result.

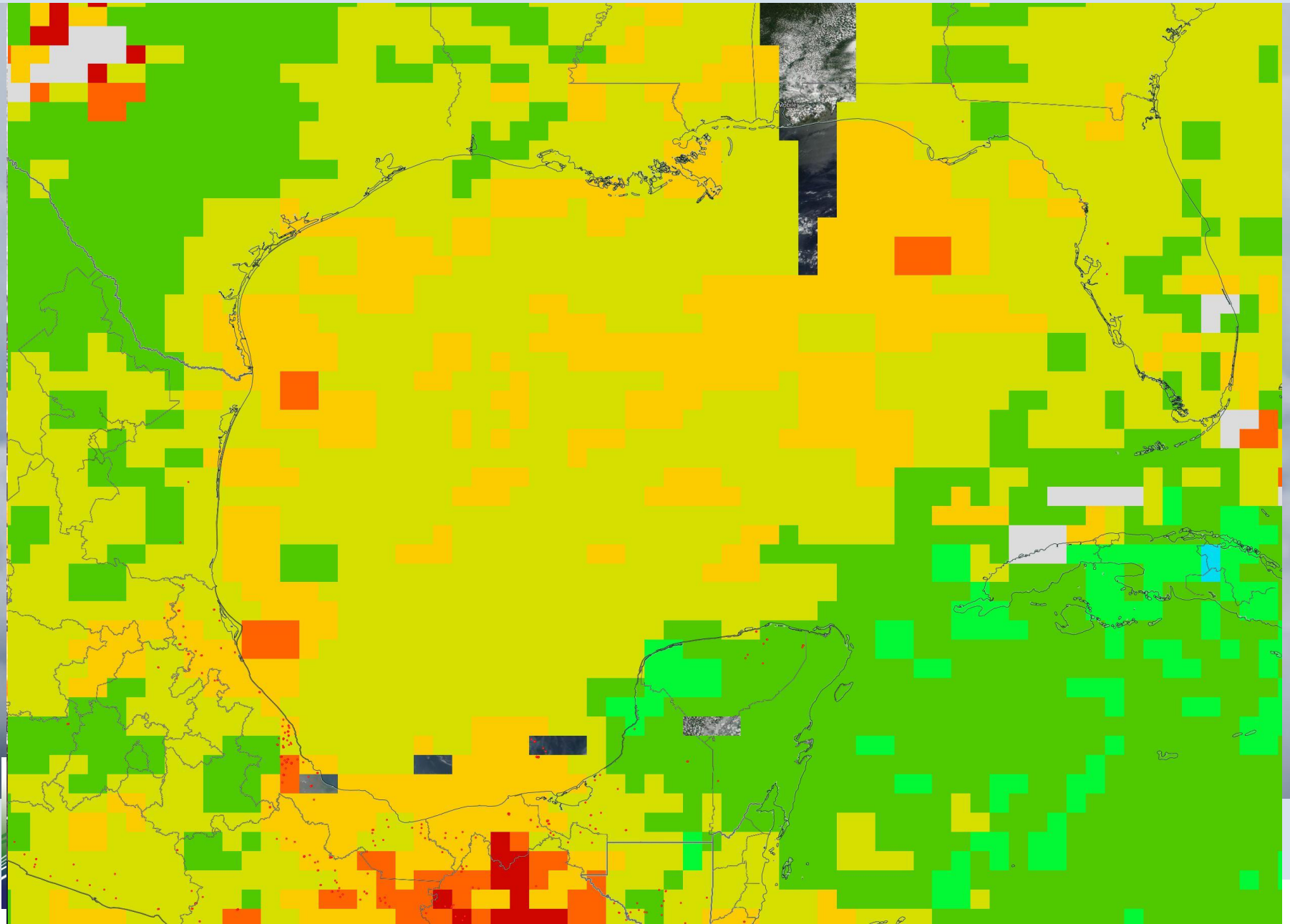
May 19, 2016 Winds and Temp 850mb



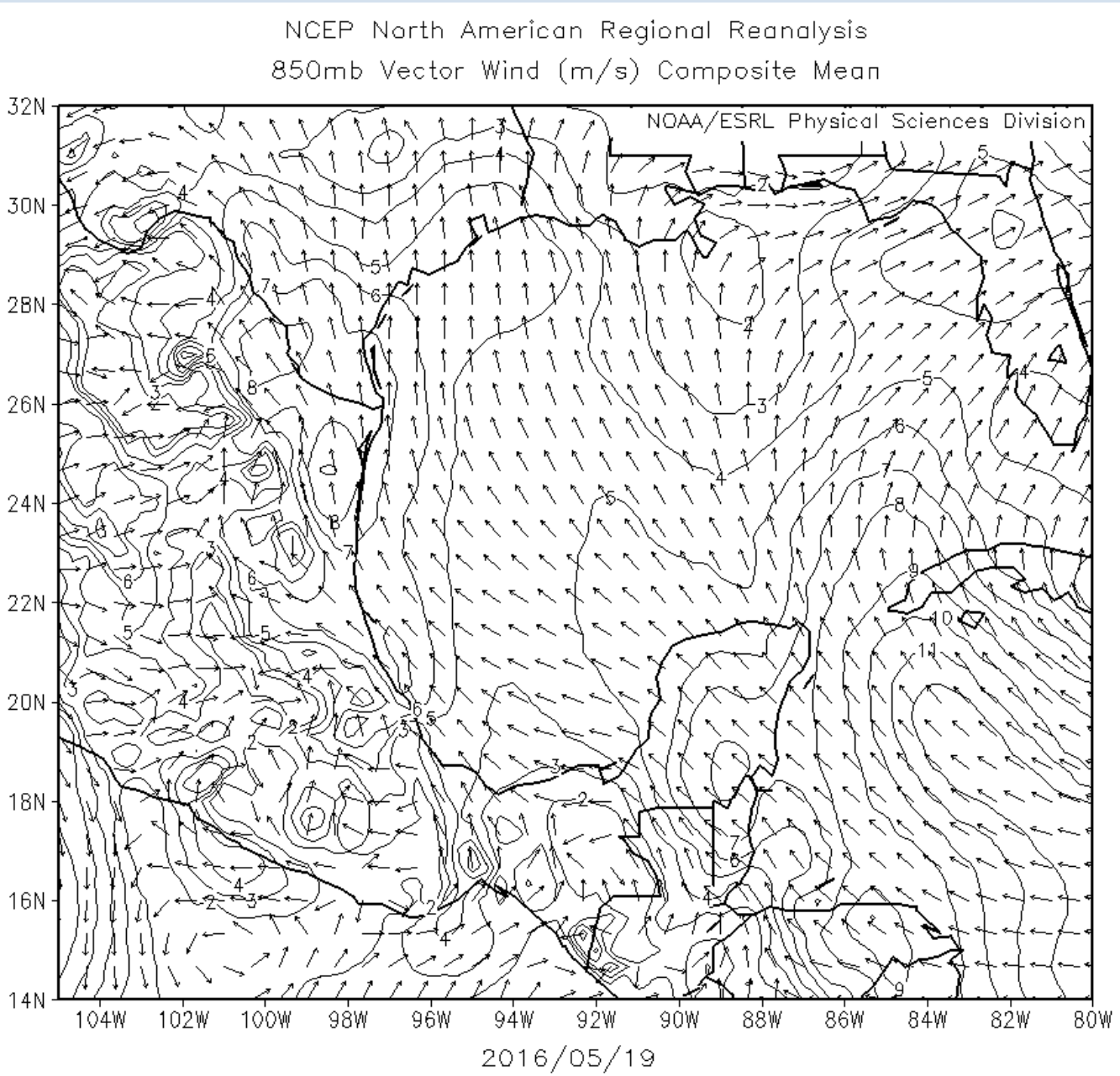
May 19, 2016 HMS Smoke and Fires



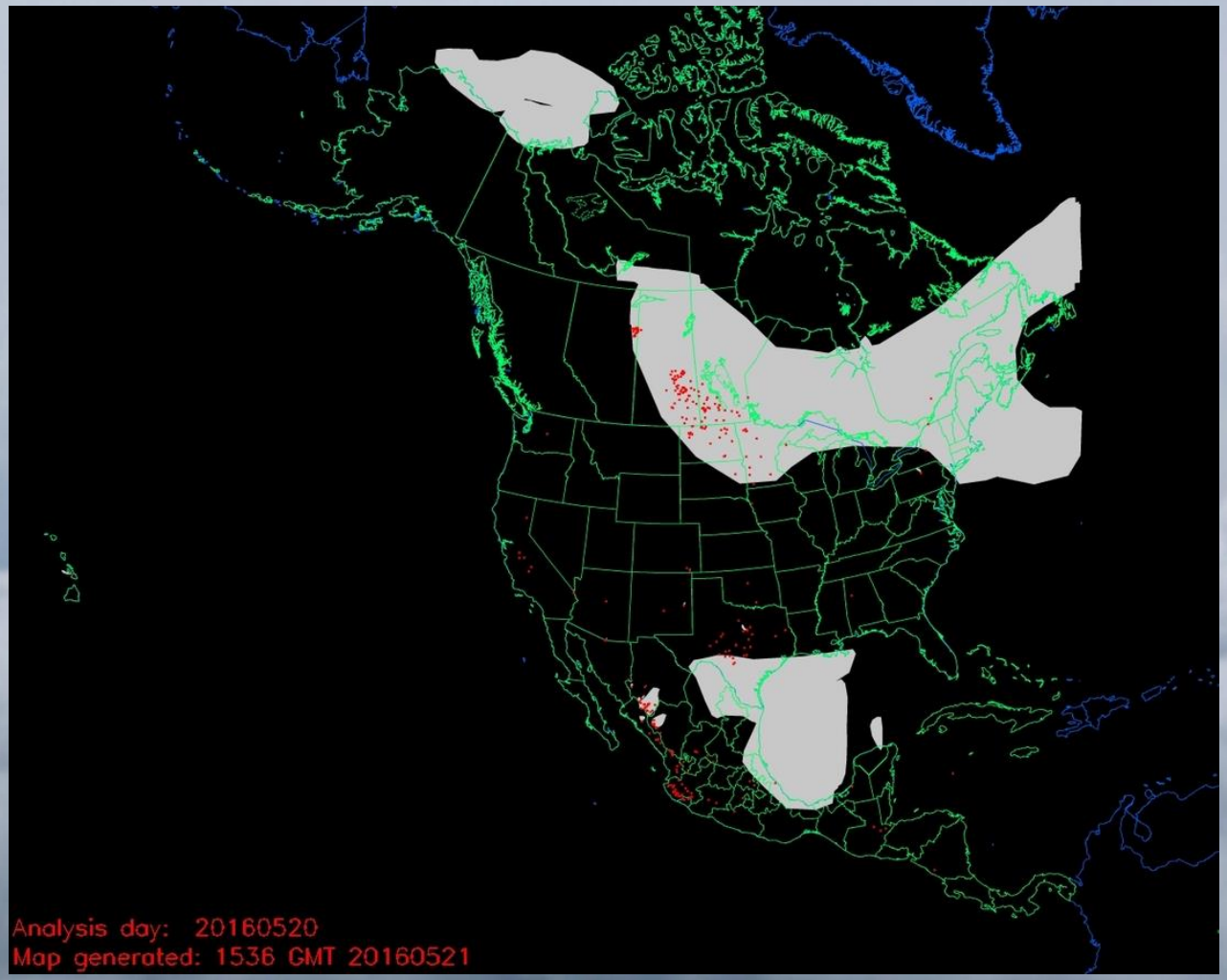
May 19, 2016 AOD and CO



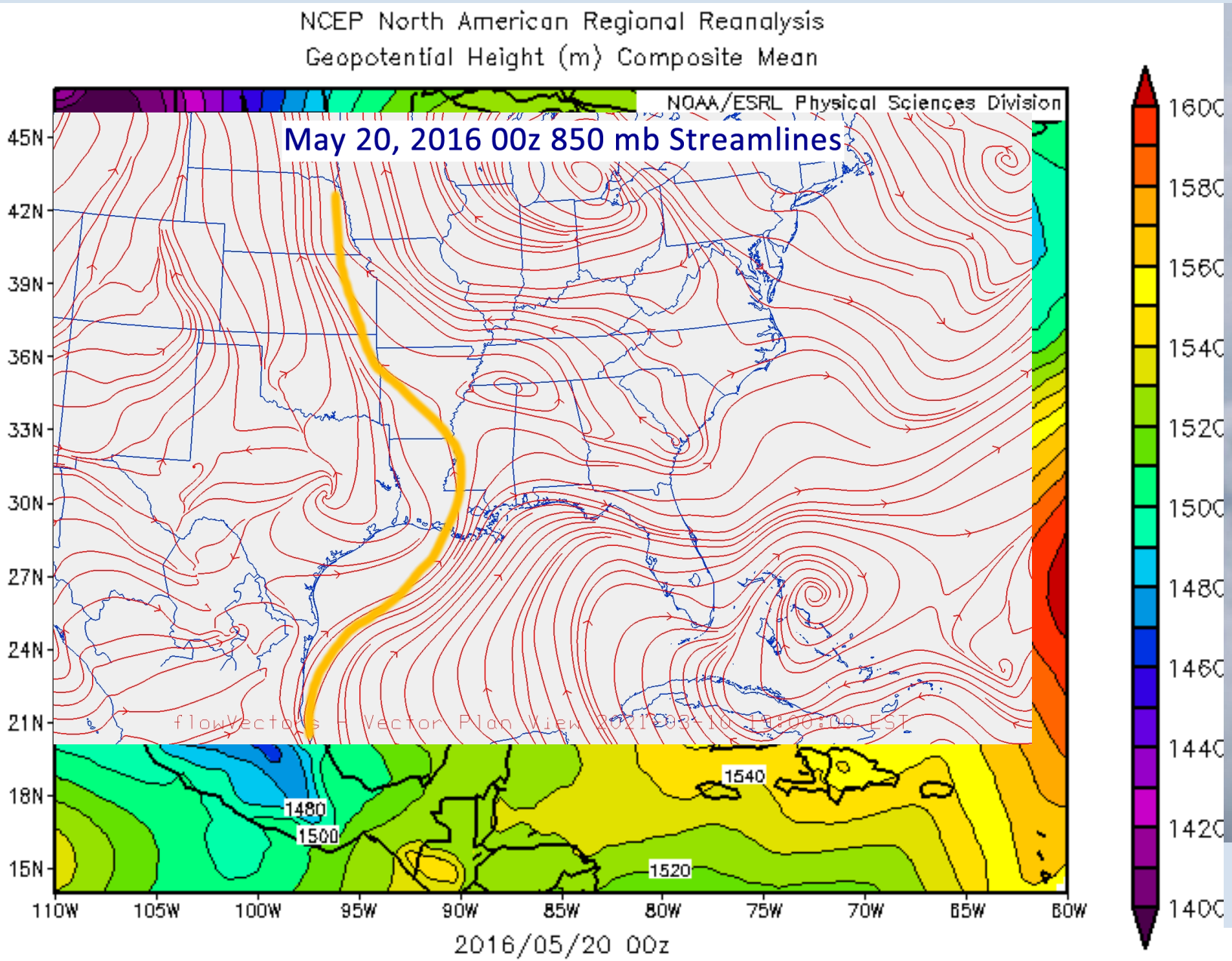
850 mb Vector Wind Animation



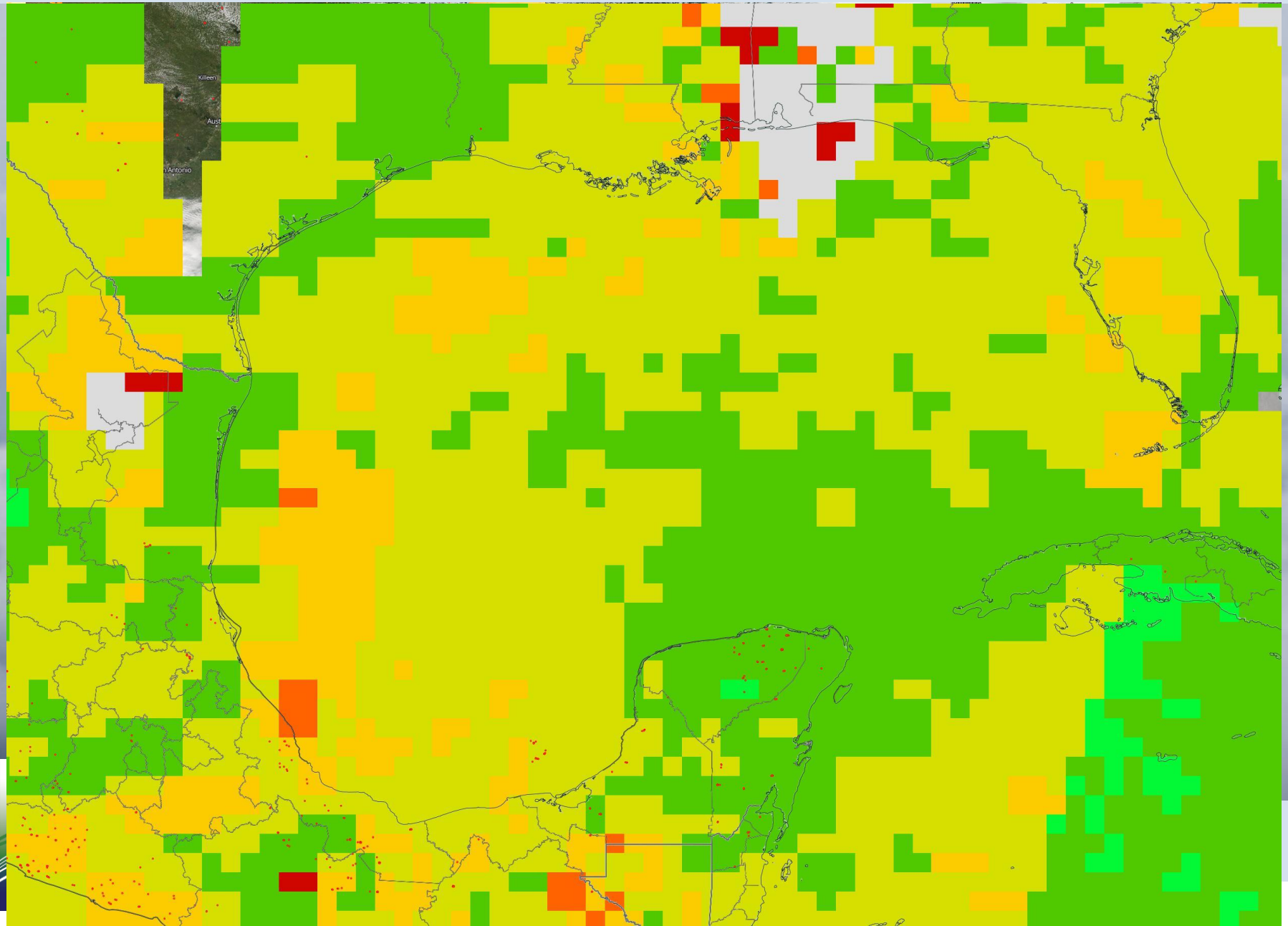
May 20, 2016 HMS Smoke and Fires



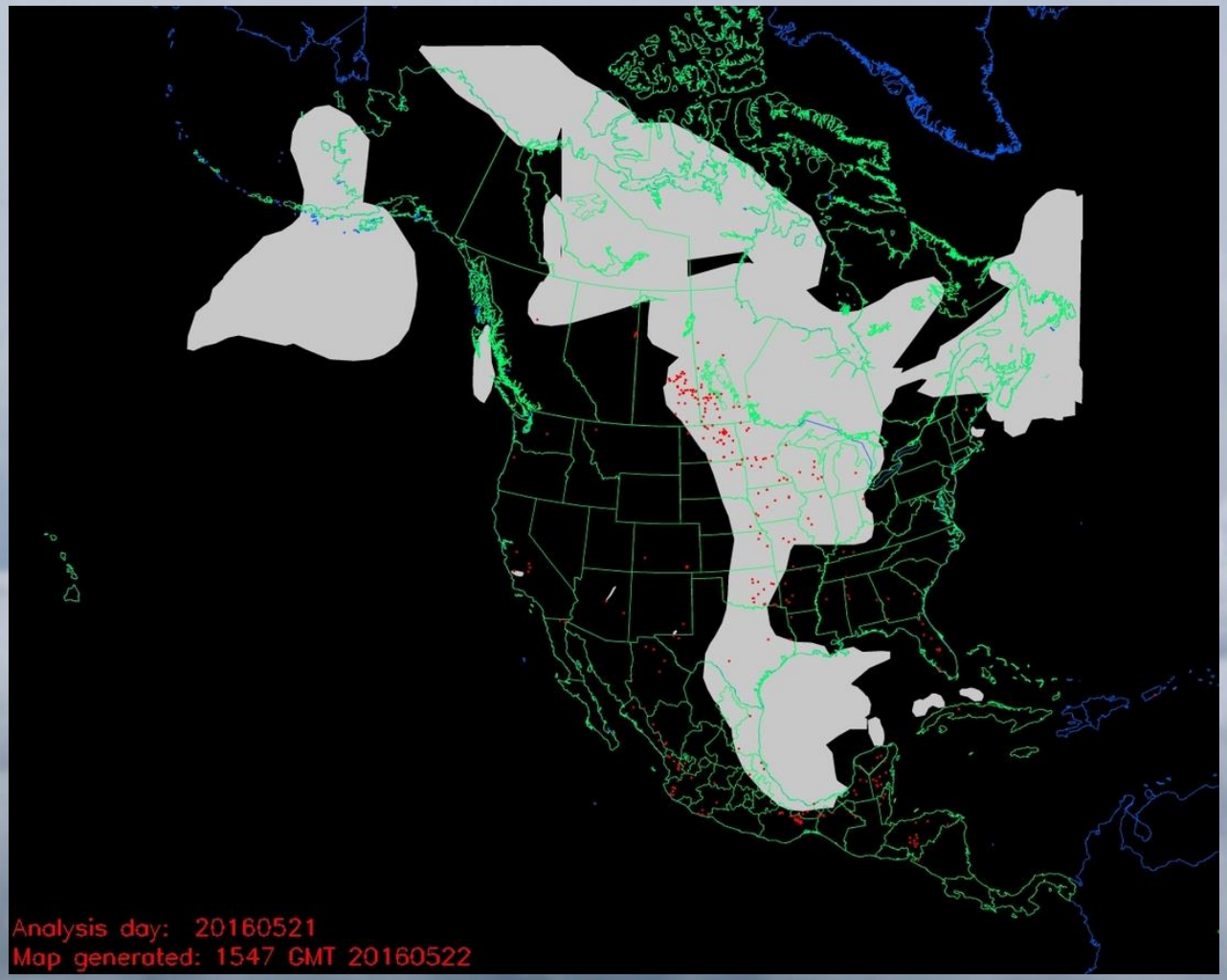
May 20, 2016 00z 850 mb Pattern



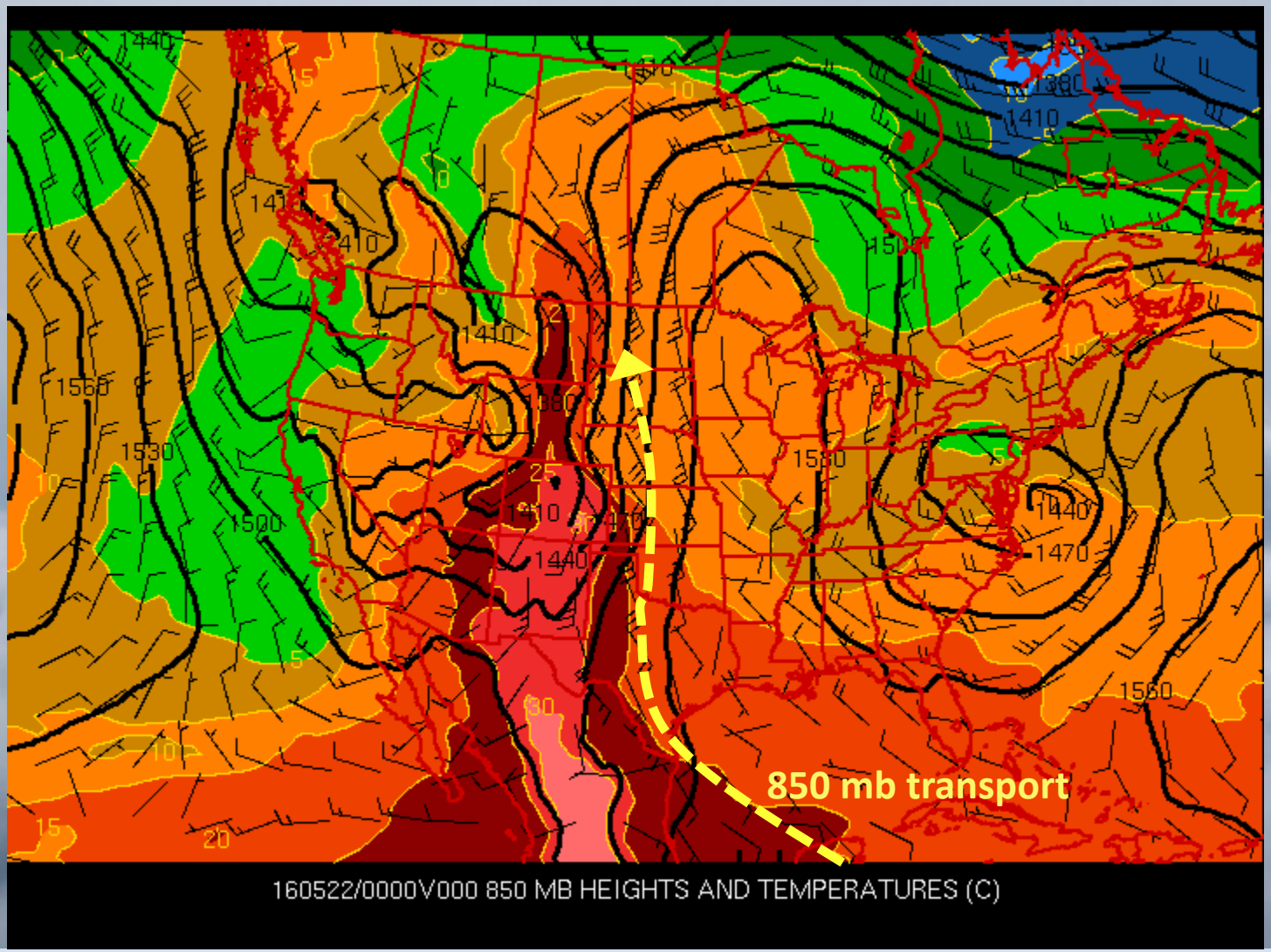
May 20, 2016 AOD and CO



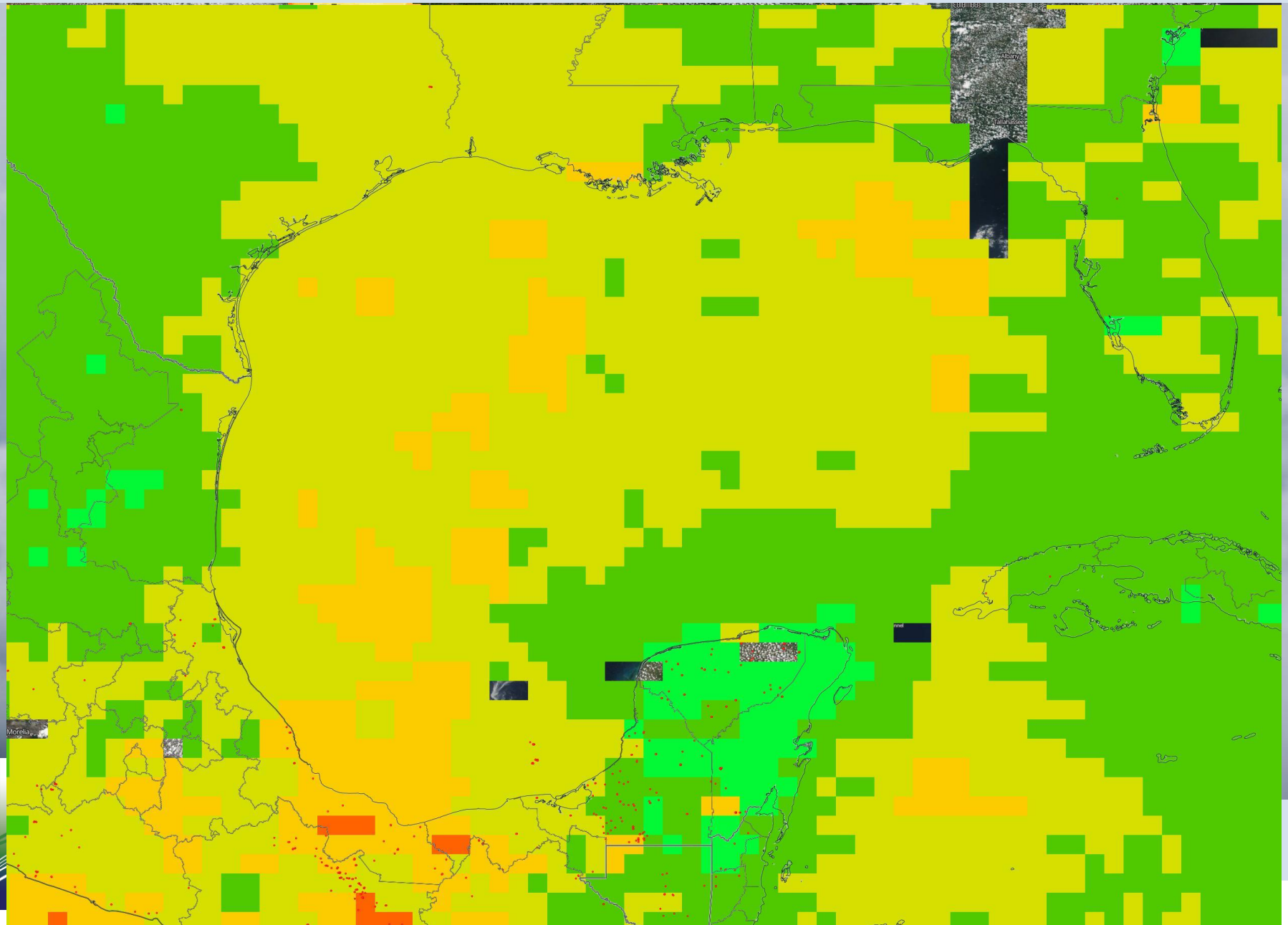
May 21, 2016 HMS Smoke and Fires



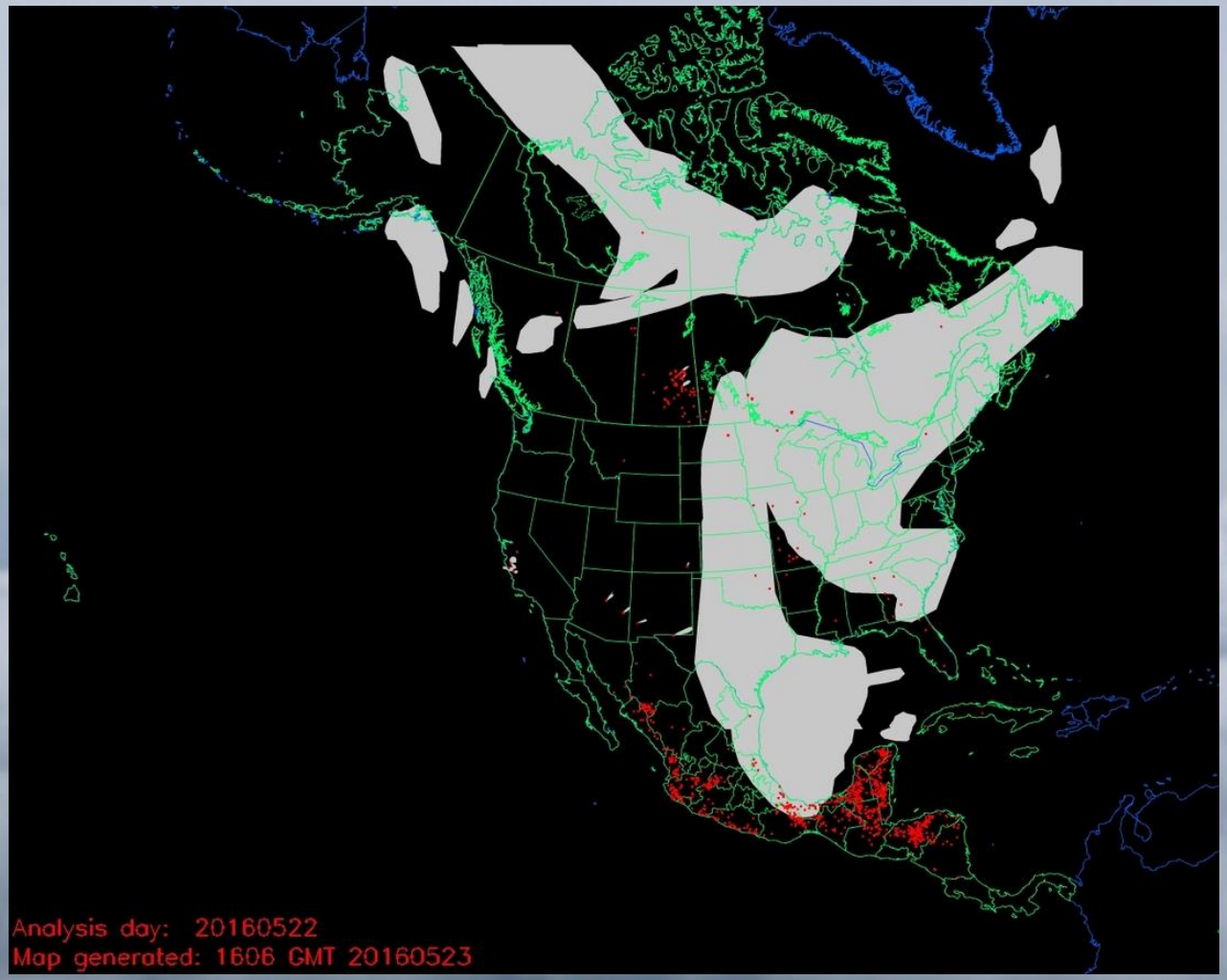
May 21, 2016 Winds and Temp 850mb



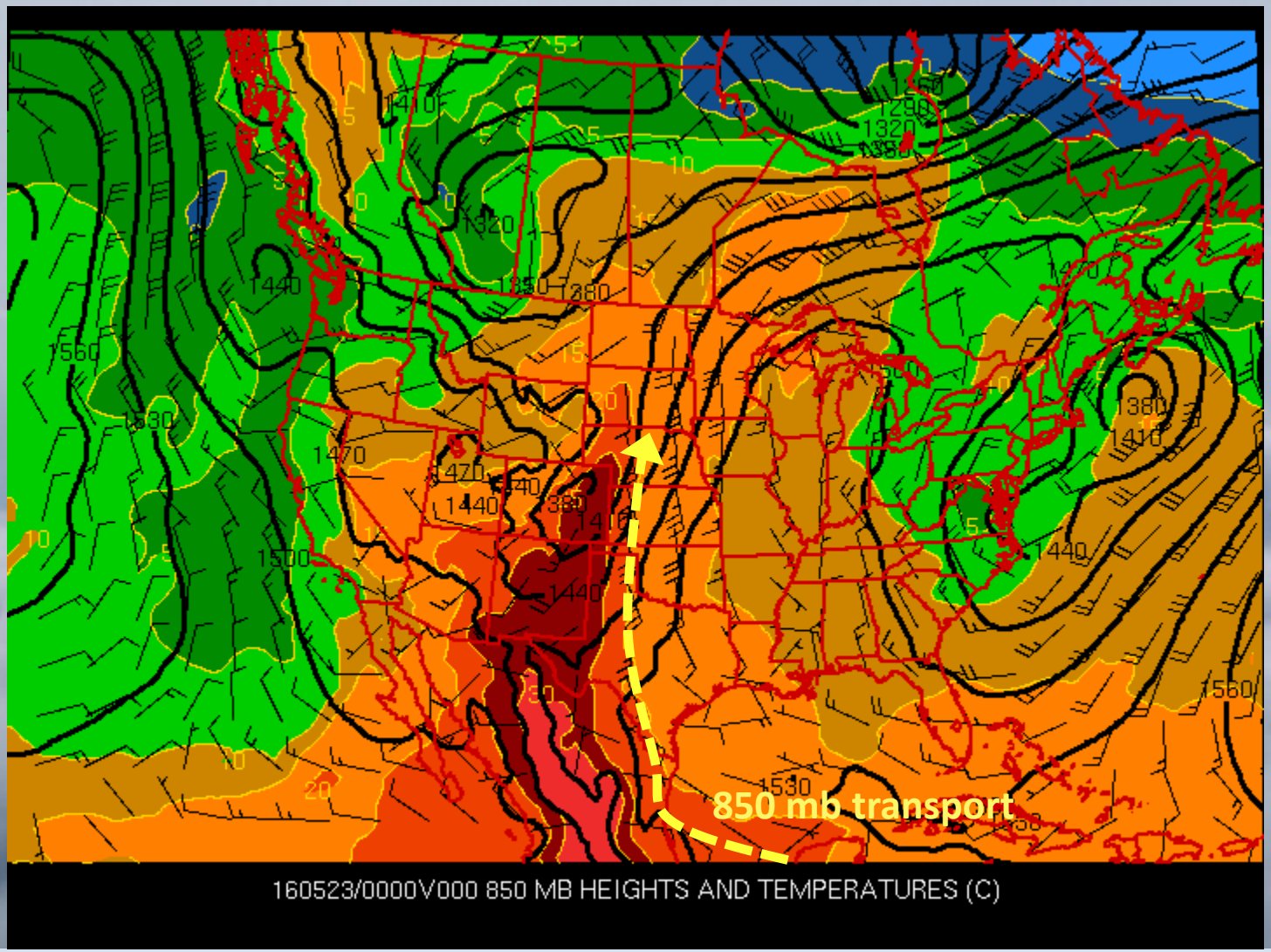
May 21, 2016 AOD and CO



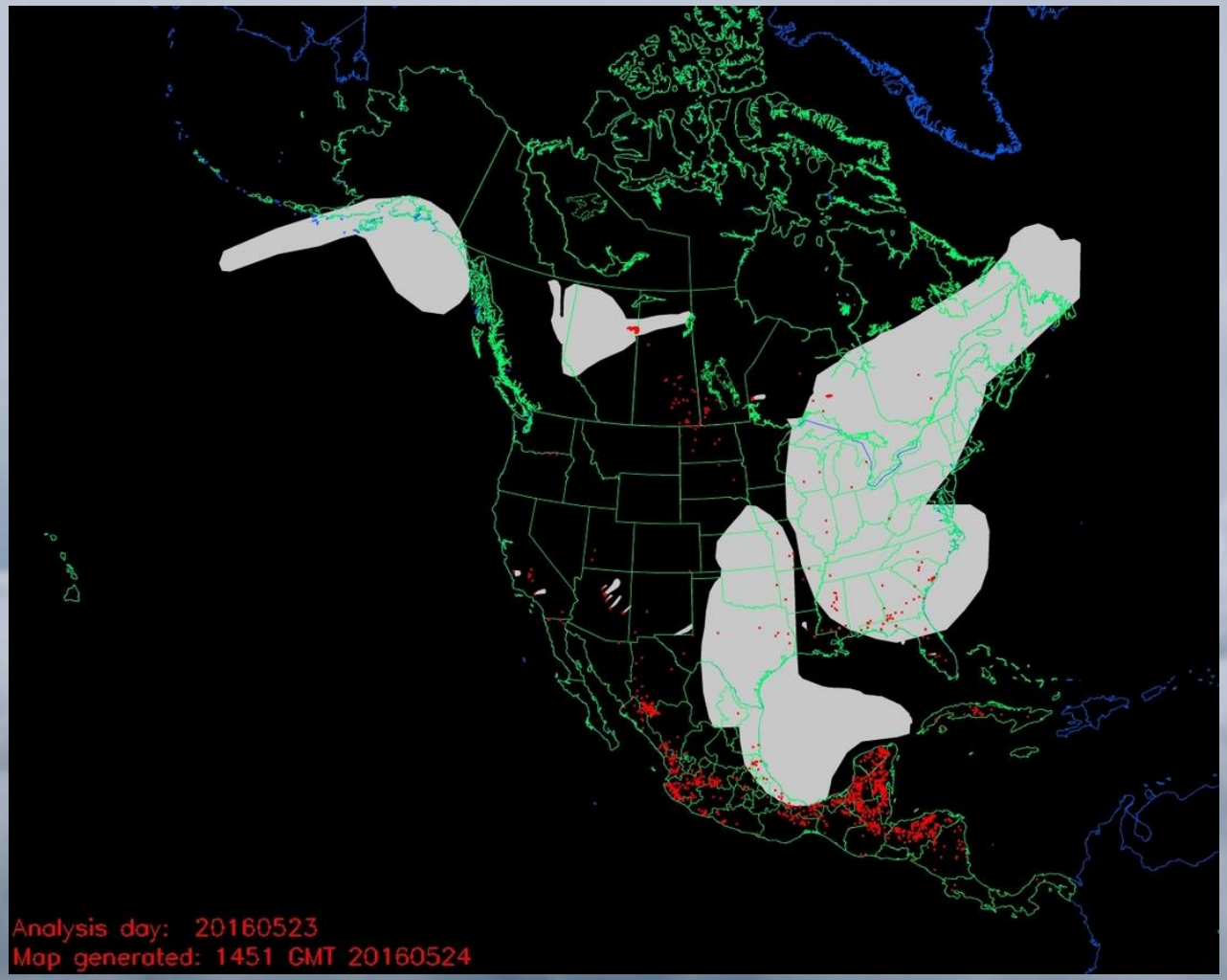
May 22, 2016 HMS Smoke and Fires



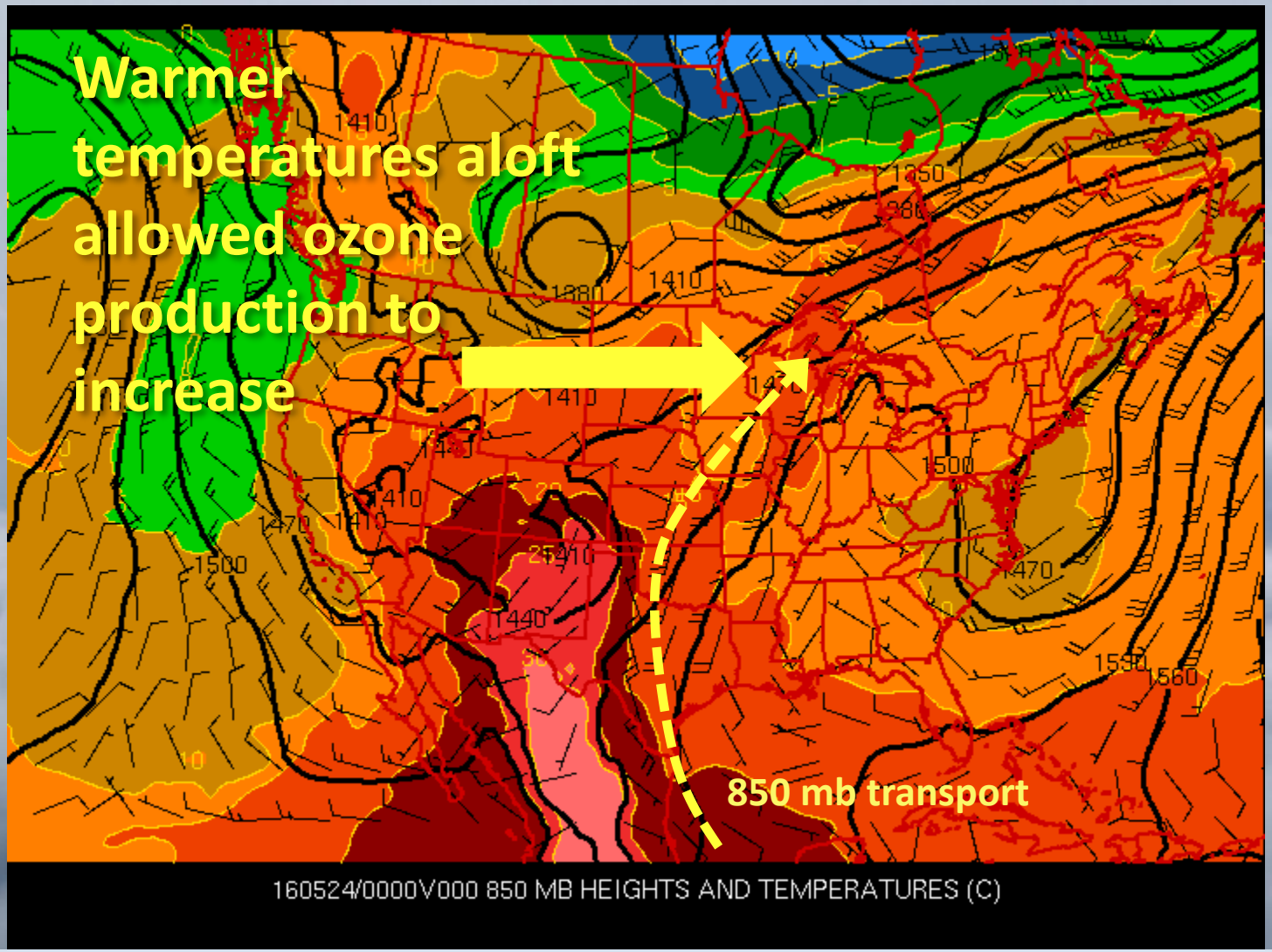
May 22, 2016 Winds and Temp 850mb



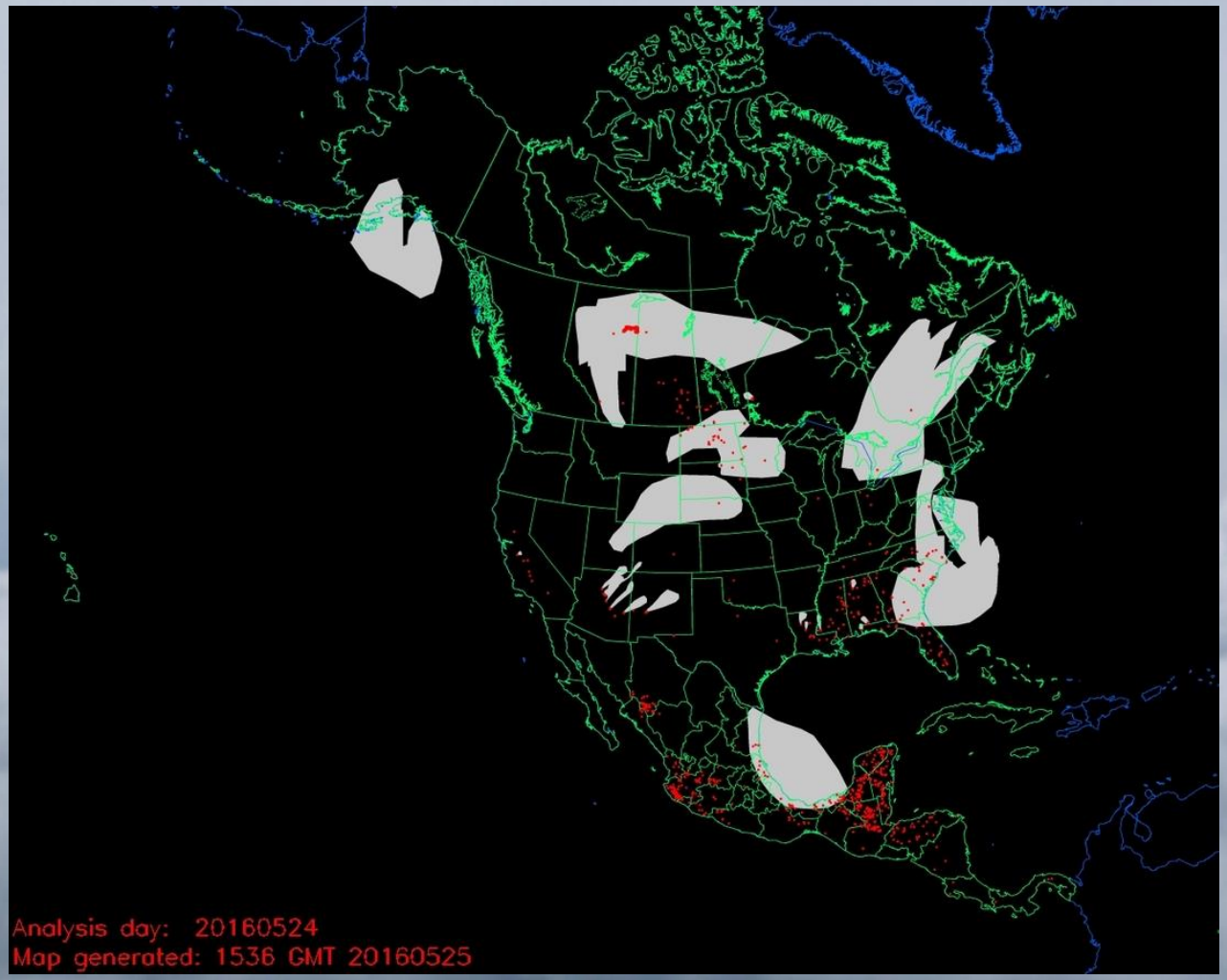
May 23, 2016 HMS Smoke and Fires



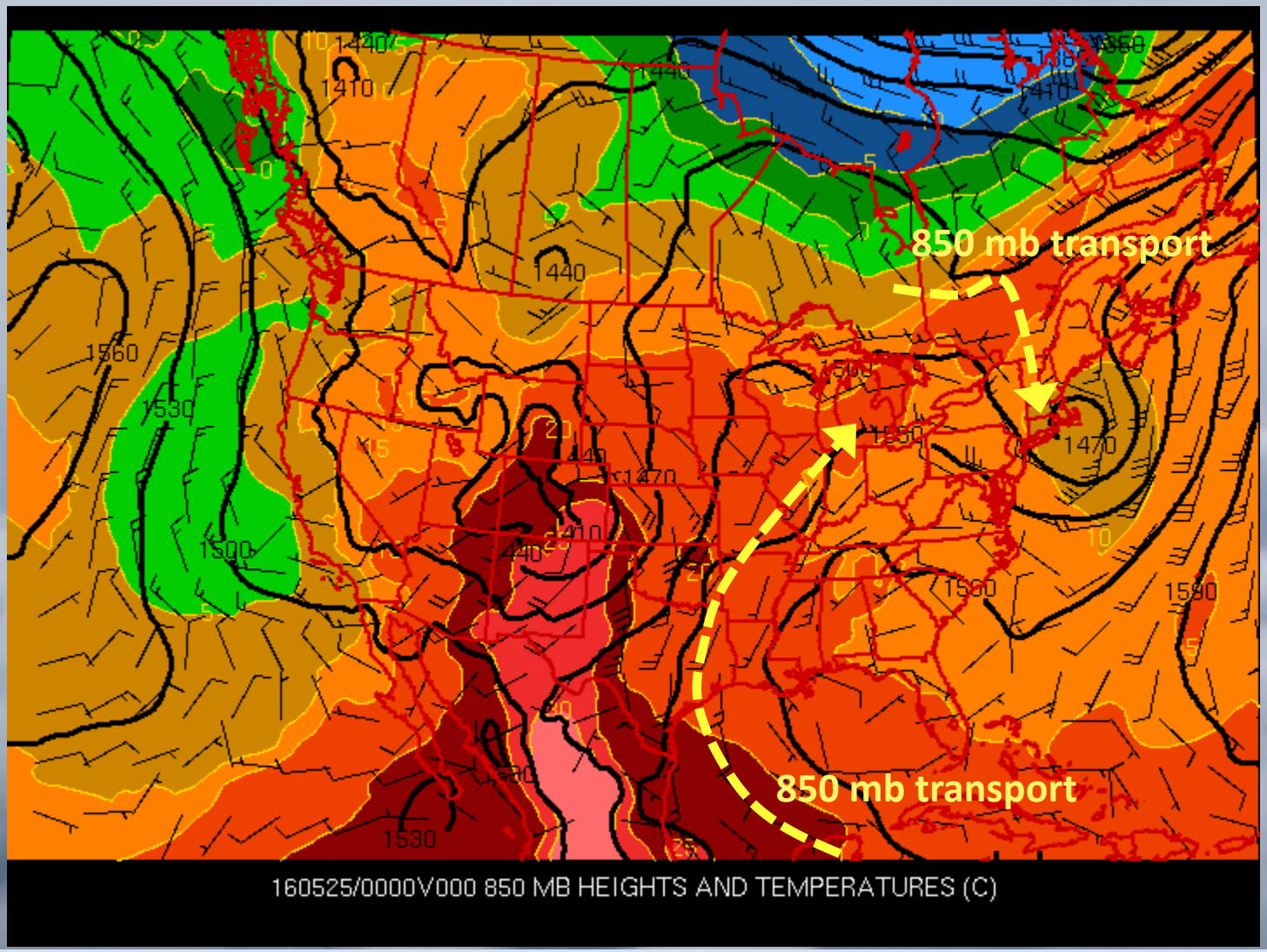
May 23, 2016 Winds and Temp 850mb



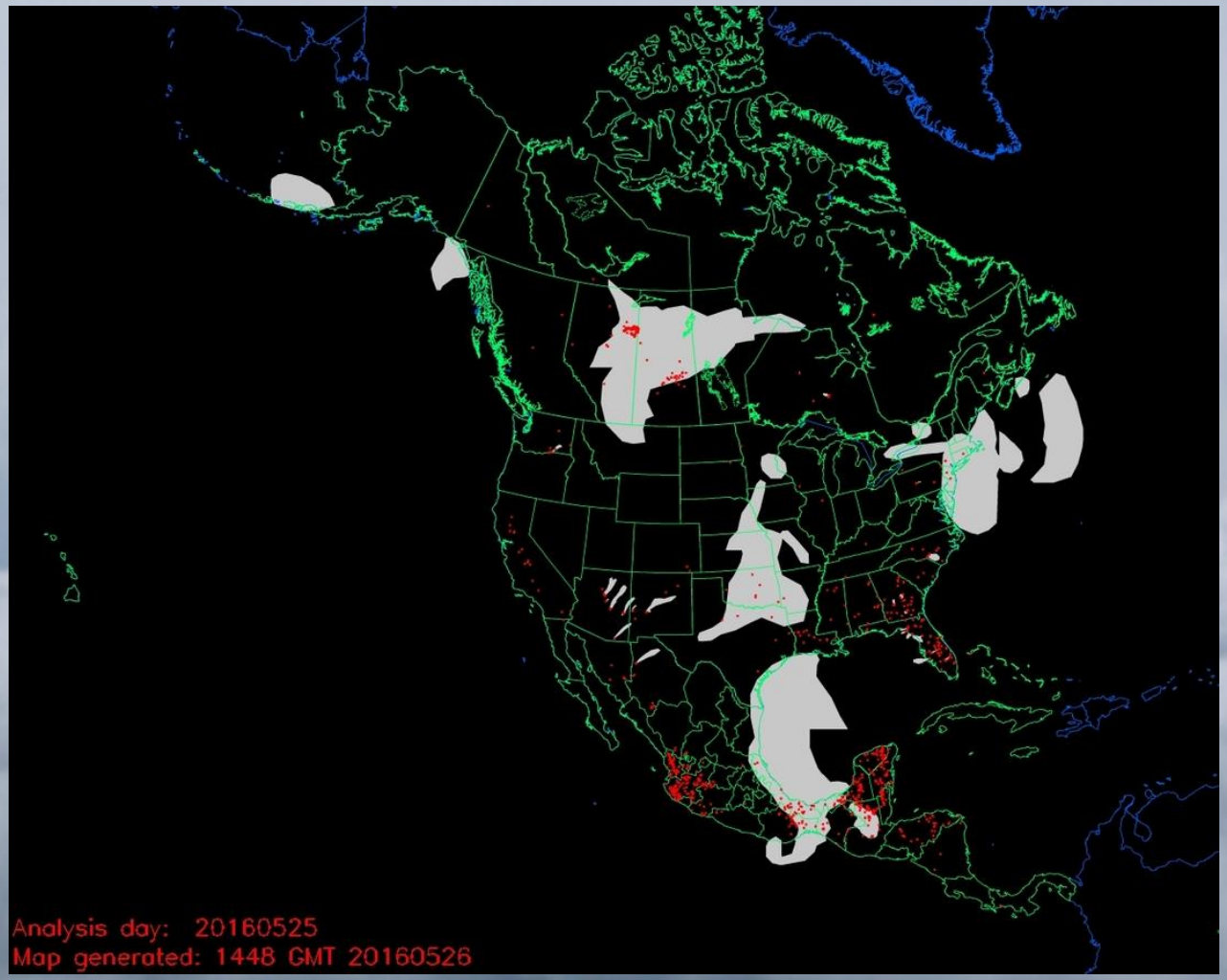
May 24, 2016 HMS Smoke and Fires



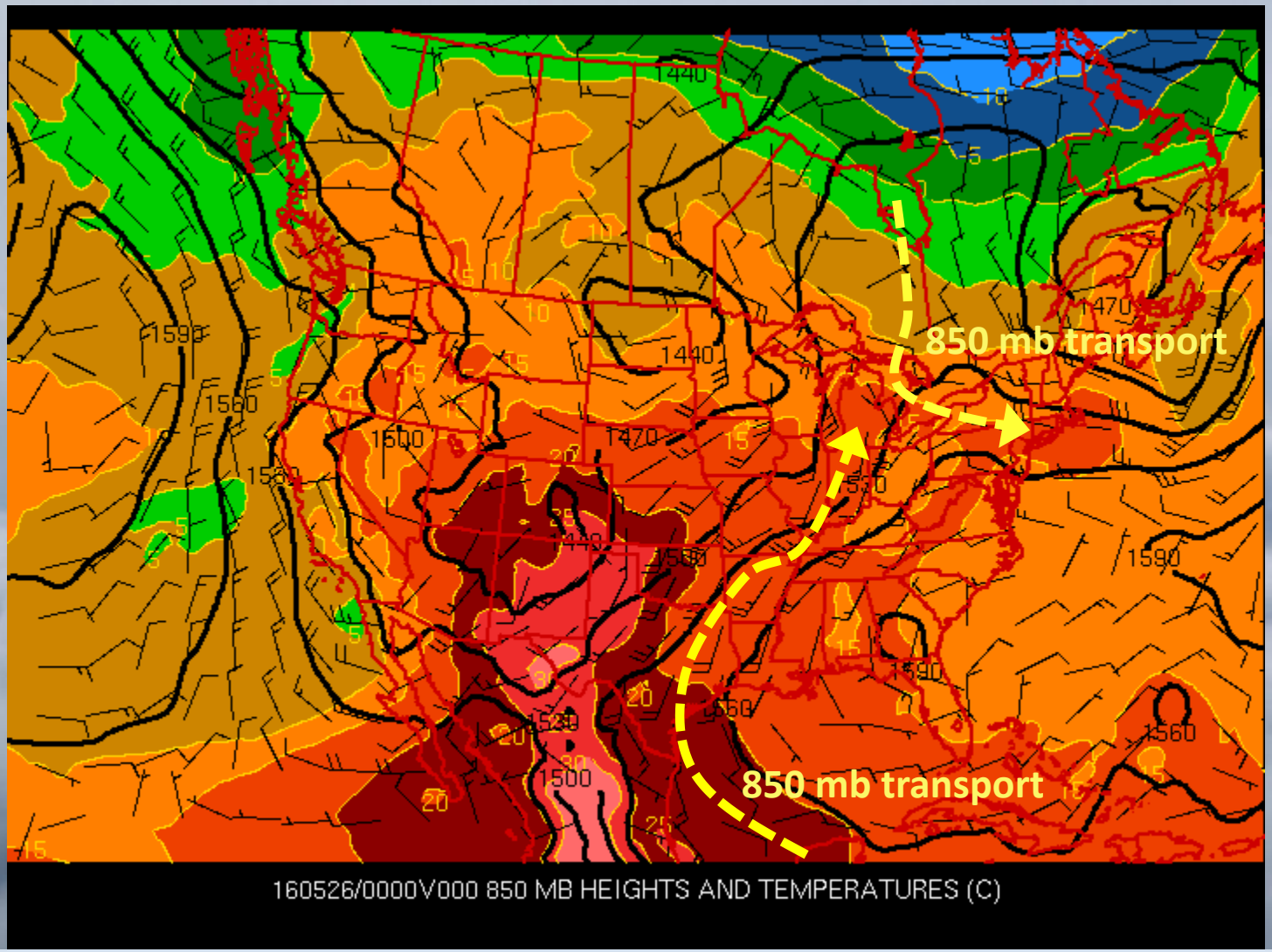
May 24, 2016 Winds and Temp 850mb



May 25, 2016 HMS Smoke and Fires



May 25, 2016 Winds and Temp 850mb



Tracking Smoke Plumes using IMPROVE

- IMPROVE was established to track progress for the Regional Haze Rule (sampling every 3rd day);
- Potassium (K) is a useful indicator of the presence of a smoke plume;
- Seney National Wildlife Refuge was chosen because much of the wildfire plumes were concentrated in that area of the upper Midwest for multiple days during May 2016;
- Other sites from the Chemical Speciation Network (CSN) need to be considered to track the plume as it moved eastward from the Midwest.

IMPROVE Class 1 Monitoring Sites

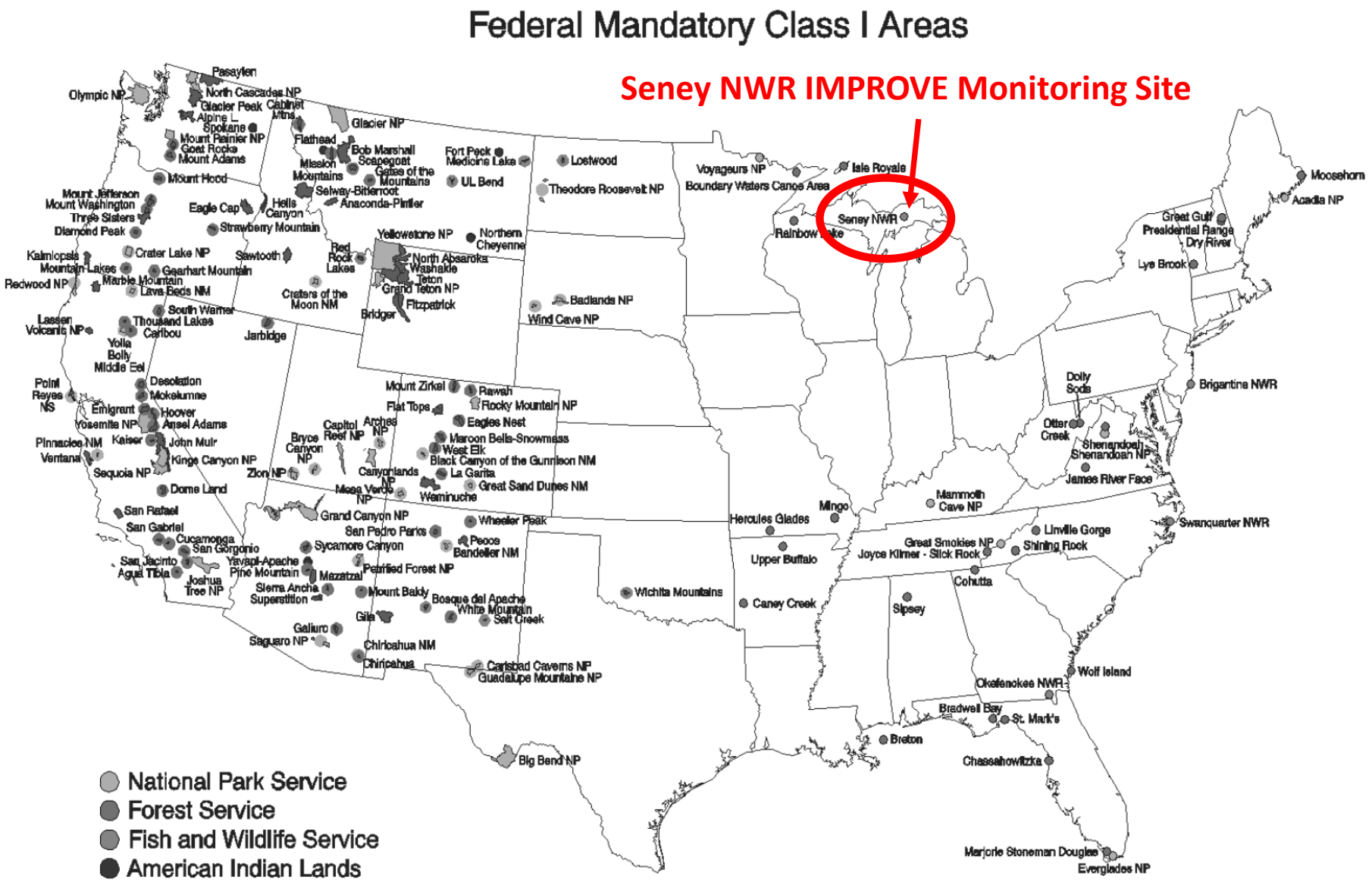
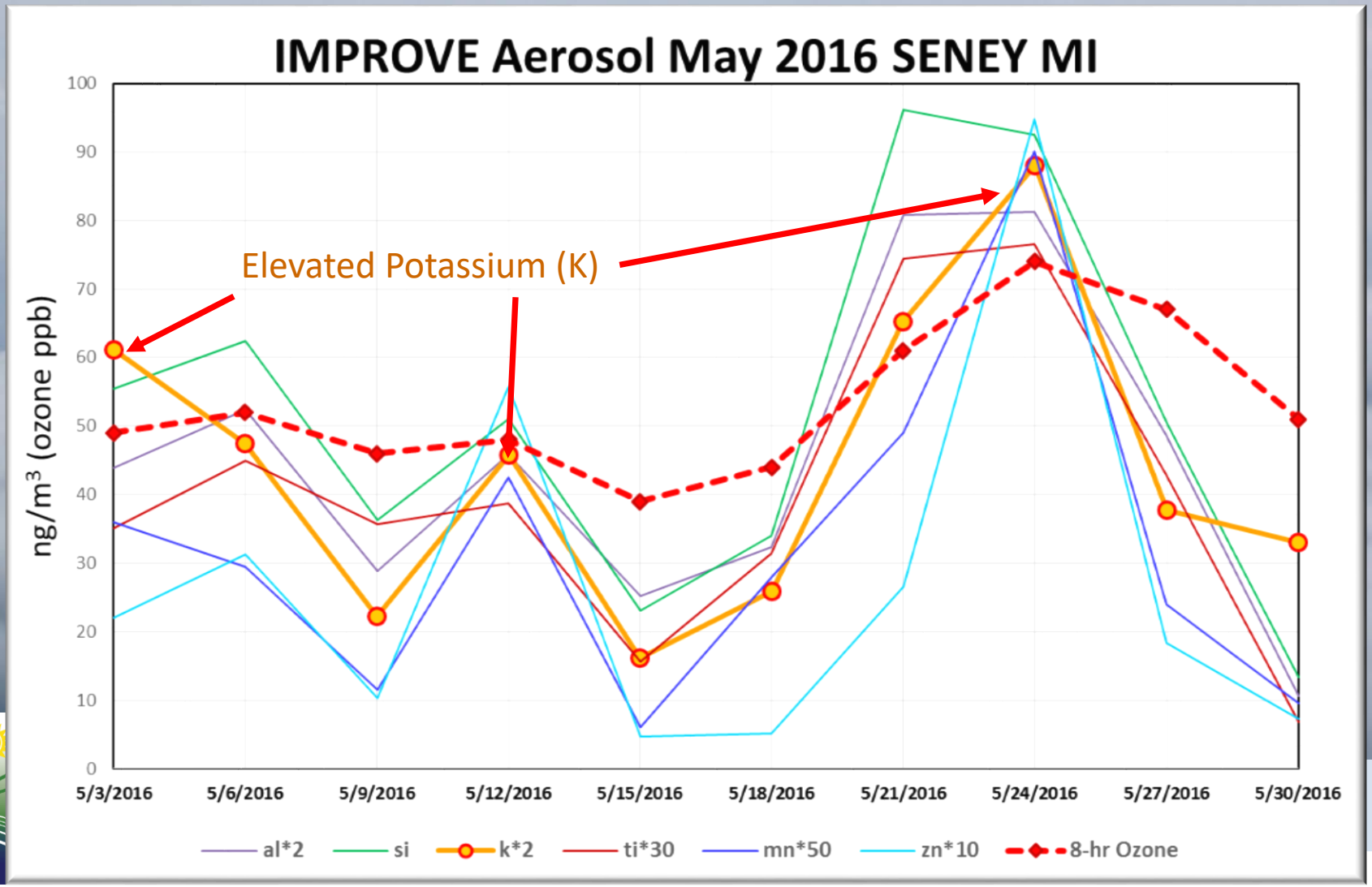


Figure 1.1. Class I areas of the contiguous United States. The shade coding identifies the managing agency of each Class I area.

Selected IMPROVE Data Seney, MI

- Potassium (K) ,as well as other aerosols, spiked during days when ozone was elevated;
- Note that the concentrations have been scaled to compare with the ozone levels.



Conclusions

- Although the Potassium levels increase at SENEY, especially on May 21st and May 24th, other aerosols also increase for reasons unknown;
- Need to obtain EC/OC data to more accurately ascertain the presence of smoke at the surface;
- The Yucatan fire influence is now firmly established and will be incorporated into the conceptual model;
- Will be plotting NJ and PA CAMD data for summer 2016 to compare with the NY results;
- Will be choosing similar meteorological back trajectory days for comparison;
- Will be analyzing monitoring data from western MA, southern VT and NY to determine outliers.

Connecticut Department of Energy and Environmental Protection